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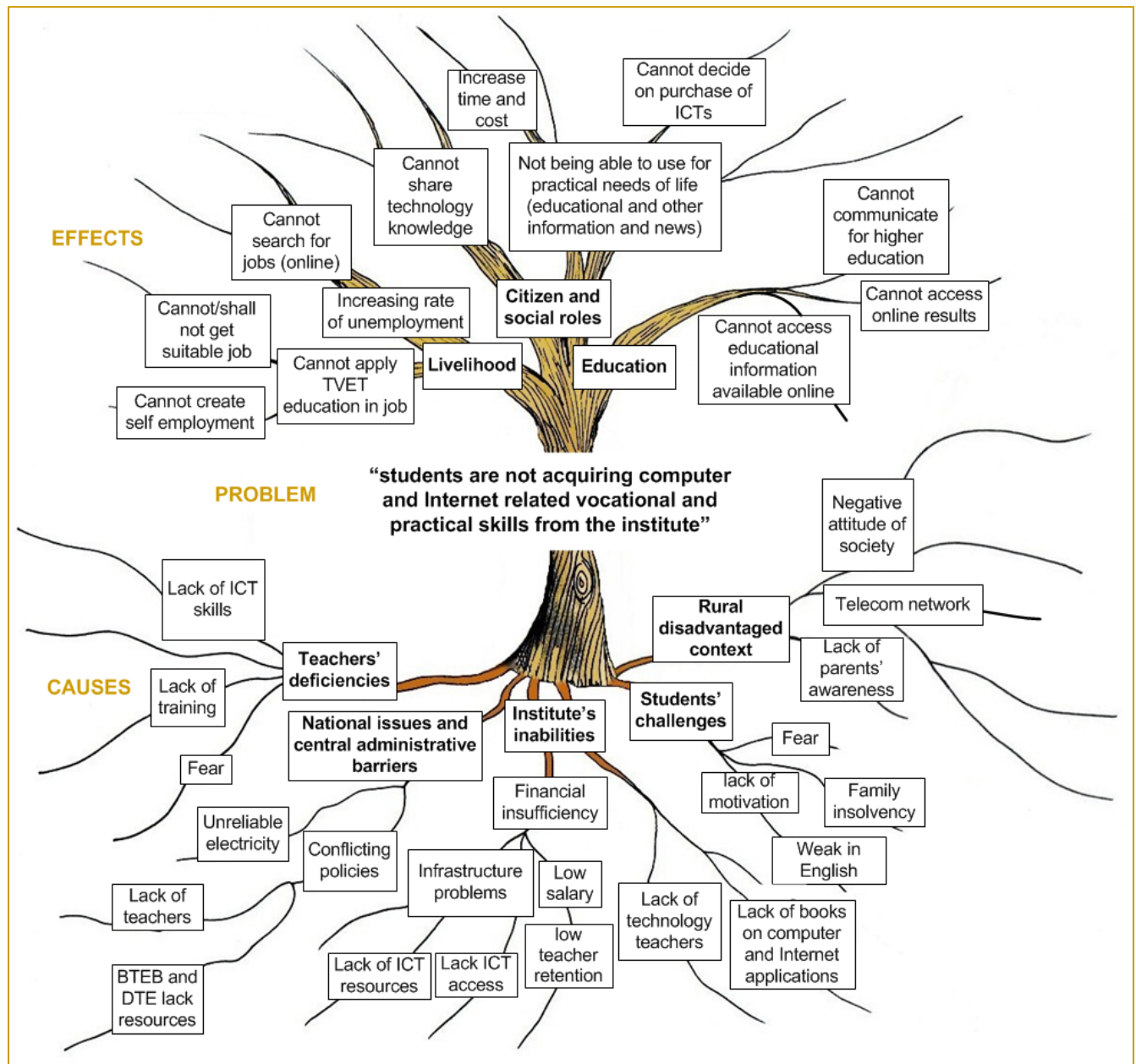
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Secondary Educational Institution Centered Diffusion of ICT in Rural Bangladesh



A thesis submitted to the Faculty of Humanities at Aalborg University for the degree of
Doctor of Philosophy

Md. Saifuddin Khalid

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A thesis submitted to the Faculty of Humanities at Aalborg University for the degree of Doctor
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Front page picture is recreated and redesigned based on the figure entitled “Partial View of Problem-Tree Analysis of Teachers and Students of Rural Vocational Institute” in paper III of this dissertation.

ENGLISH SUMMARY

Title: *Secondary Educational Institution Centered Diffusion of ICT in Rural Bangladesh*

This dissertation presents a holistic approach for exploring, analyzing, solving, and circumventing the barriers to the integration and adoption of ICT in relation to the learning environments of secondary educational institutions in rural Bangladesh. It contributes to the fields of ICT for development (ICT4D) and educational technology in the scope and findings as follows. The current literature lacks a holistic understanding of the complexities of the barriers that are rooted and entangled across individual, social, and organizational policies and power structures. Moreover, there is an absence of empirical studies for the diffusion of ICT using mixed methods, methodological appropriation, and practical diffusion strategy identification. Therefore, I have taken my motivation from the “Vision 2021: Digital Bangladesh” initiatives and consider that ICT is a relatively new field in the secondary education systems (i.e., covering grades 6–12) in Bangladesh. Having positioned this investigation within the transformative paradigm, I took six strategic approaches to diffuse ICT in the learning environment of the stakeholders in rural private vocational school. The ICT diffusion strategies were: an integrated purchase and training facilitation, smart classroom implementation, educational administration, extracurricular activities, a non-formal computer literacy center, and school-based internship. Two live-in field studies were conducted: from August 2011 to January 2012 and from August 20, 2012 to September 29, 2012. Building on ethnographic action research (EAR) methodology and applying participatory learning and action (PLA) methods, the stakeholders’ problems and inquiries were identified and the diffusion strategies were initiated or adapted. This dissertation is based on papers submitted, accepted, and published during the PhD period and consists of two parts. Part I introduces and positions the study in terms of ICT adoption barriers, introduces Rogers’ theory of diffusion of innovations as the guide for a change agent, and theoretically frames the strategic interventions. Part II consists of eight papers that focus on but are not limited to different aspects of the topic: project plan, literature review, application of PLA methods, and mapping the barriers in a framework of macro-meso-micro levels, current practices, and investigation of different diffusion strategies. Central to these papers are participatory methods and the iterative phases of methodology, which demonstrate the application of Rogers’ theory in qualitative research using mixed methods.

What I found was that central to the barriers are lack of funds, high distrust, a lack of skilled human resources—particularly computer graduates, subject-specific teachers—and a lack of technical support for computers, electrical devices, and electronics. These barriers are situated at the levels of individual stakeholders, organizations that are part education systems’ rules and regulations, and the external environment comprised of social and non-social factors.

The public policies governing secondary education systems' employment, curriculum, and assessment form a central diffusion system, where the overall control of decisions and the direction of diffusion is in the hands of government administrators and technical subject-matter experts. The barriers faced by the schools' stakeholders do not have the scope to be heard and facilitated. Therefore, this dissertation devises a hybrid diffusion system that recommends applying two-way communication and appropriating skilled human resources at local levels. The question remains as to how a scale-up experiment of a hybrid diffusion system can be conducted to address the barriers to funding, knowledge, and skills in relation to ICT in secondary education.

DANSK RÉSUMÉ

Title: *Ungdomsuddannelsesinstitution som omdrejningspunkt for udbredelsen af IKT i landdistrikt i Bangladesh*

Denne afhandling præsenterer en holistisk tilgang til at udforske, analysere og omgå barrierer for integration og indførelse af IKT i læringsmiljøer i ungdomsuddannelser i landdistrikterne Bangladesh. Afhandlingen bidrager til områderne ICT for development samt ikt-støttet læring på følgende måder. Forskningslitteraturen mangler en holistisk forståelse af de komplekse og sammenvævede barrierer, der går på tværs af de enkelte samfundsmæssige niveauer, strukturer og processer. Desuden er der mangel på empiriske undersøgelser der anvender en blanding af forskellige kvalitative og intervenserende metoder med henblik på identifikation og test af diffusionsstrategier. Derudover tager projektet afsæt i "Vision 2021: Digital Bangladesh" og dertil knyttede initiativer rettet mod højere niveauer i grundskolen og ungdomsuddannelser i Bangladesh hvor IKT er et relativt nyt felt. Forskningsprojektet placerer sig i det transformativt paradigme og udvikler og tester seks strategiske tilgange til diffusion af IKT i læringsmiljøer i en erhvervsskole beliggende i et landdistrikt i Bangladesh. De seks strategier er: integreret støtte til køb af udstyr og uddannelse i at bruge det, smart class room implementering, udvikling af skolens administration med IKT, fritidsaktiviteter med ikt, Ikt-undervisningsenhed baseret på frivillig deltagelse af skolens elever, og skolebaseret praktik. To feltstudier blev gennemført: fra august 2011 til januar 2012 og fra august 2012 til slutningen af september 2012. Undersøgelser og udviklingsarbejde var baseret på en kombination af etnografiske studier og aktionsforskning, hvor dataindsamling og forandring var baseret på deltagernes problemforståelse og forandringsspektiver.

Denne afhandling er baseret på artikler der er indsendt til fagfællebedømmelse (alle), accepteret (de fleste – resten stadig under bedømmelse) og offentliggjort (halvdelen) i løbet af phd-studiet og består af to dele. Del I introducerer og positionerer undersøgelsen om barrierer for ikt-adoption, introducerer Rogers' teori om diffusion af innovationer som guide for en forandringsagent og teoretisk ramme for de strategiske interventioner. Del II består af otte artikler, som fokuserer på forskellige aspekter af projektet: projektplan, litteraturreview, anvendelse af metoder og kortlægning barrierer inden for rammerne af makro-, meso-, mikroniveau, gældende praksis og undersøgelse af forskellige diffusionsstrategier. Centralt i disse artikler er deltagerorienterede metoder og iterative gennemløb, som viser anvendelsen af Rogers' teori i kvalitativ forskning ved hjælp af en vifte af kvalitative metoder. Det blev konstateret, at centrale barrierer er mangel på finansiering, høj mistillid og mangel på kvalificerede menneskelige ressourcer, især ikt-uddannede, faglærere og teknisk support til computere og elektronik. Disse barrierer er beliggende på flere niveauer: de enkelte aktører, organisationer, der er en del uddannelsessystemer "regler og bestemmelser, og det eksterne

miljø består af sociale og ikke-sociale faktorer. De offentlige politikker for erhvervsuddannelser, pensum og bedømmelse er centrale udfordringer, hvor den overordnede kontrol og styring lægger ansvaret for ibrugtagningen af ikt i hænderne på den centrale statslige administration. Det er barrierer, som skolernes lokale interessenter ikke har mulighed for at gøre noget ved. Denne afhandling udvikler et hybrid diffusions-system, som bygger på to-vejs kommunikation og fagligt kvalificerede eksperter lokalt på skolerne. Tilbage står spørgsmålet om hvordan dette system kan skaleres op og bruges til at håndtere mangel på ressourcer, viden og færdigheder i relation til ikt på tværs af hele erhvervsuddannelsessystemet i Bangladesh?

LIST OF PAPERS

- Paper I:** Khalid, M. S. (2011). ICT in education: Secondary technical vocational education and training institute centered diffusion of innovation in rural Bangladesh. In *Proceedings of International Technology, Education and Development Conference (INTED 2011)* (pp. 1126–1134). Presented at the International Technology, Education and Development Conference (INTED 2011), Valencia, Spain: International Association of Technology, Education and Development (IATED).
- Paper II:** Khalid, M. S., & Buus, L. (*Submitted*, 2013). A theoretical framework mapping barriers of integrating and adopting educational technology. *Research and Practice in Technology Enhanced Learning*. Accepted for peer review.
- Paper III:** Khalid, M. S., & Nyvang, T. (2013). Application of PLA methods in educational technology research: A rural Bangladeshi case. In M. Georgsen & P.-O. M. Zander (Eds.), *Changing Education Through ICT in Developing Countries* (pp. 107–130). Aalborg: Aalborg University Press.
- Paper IV:** Khalid, M. S., Nyvang, T., & Islam, M. K. (*Submitted*, 2013). Moving beyond adoption barriers through exploration of teachers' and students' practice of ICT in education—a rural Bangladeshi case. *Research and Practice in Technology Enhanced Learning*. Accepted for peer review.
- Paper V:** Khalid, M. S., Islam, M. K., & Nyvang, T. (2013). Integrated Resources and Training Facilitation: A Strategic Priority when Promoting ICT in Developing Countries. *Contemporary Educational Technology*, 4(4), 263–280.
- Paper VI:** Khalid, M. S., & Nyvang, T. (*Accept with change*, 2013). From change agent to sustainable scaffolding. Presented at the International Conference on Participation and Power in Participatory Research and Action Research, Aalborg University Copenhagen. To be published as a chapter of a book published by Aalborg University Press.
- Paper VII:** Khalid, M. S., & Nyvang, T. (*Revisions required*, 2013). A change agent's facilitation process for overcoming the barriers of ICT adoption for educational administration—a case of rural-Bangladesh vocational institution. *Australasian Journal of Educational Technology*.
- Paper VIII:** Khalid, M. S. (*Submitted*, 2013). School-based extracurricular contests as a strategy to diffusing Internet literacy in rural Bangladesh. *Research and Practice in Technology Enhanced Learning*. Accepted for peer review.

DEDICATION

The dissertation is dedicated to

My parents: Late Abdus Sukur and Lutfunnessa Begum

My sisters: Shahin Akther Faizunnessa and Shahrina Akhtar

My wife: Mahmuda Parveen

My sons: Nuhan and Nubaid

My parents-in-law: Md. Muzahed Ali and Mahfuza Parveen

My brothers-in-law: Md. Hefzur Rahman, Md. Rafiqul Islam and Sabbir Mahmud Ali

My nephews: Obaidur Rahman, Ohidur Rahman, Asifur Rahman, Nafee and Nusayr

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1

Introducing the Dissertation



1. Introducing the Dissertation

The vast majority of human beings dislike and even actually dread all notions with which they are not familiar. . . . Hence it comes about that at their first appearance innovators have generally been persecuted, and always derided as fools and madmen.

— Aldous Huxley

1.1. Preamble

This dissertation is about exploring, analyzing, solving, and circumventing the barriers to the integration and adoption of information and communication technology (ICT) in relation to the educational contexts of secondary educational institutions in rural Bangladesh. The educational contexts include formal, non-formal, and informal learning environments (Cilesiz, 2008, pp. 234–238). The main focus of the dissertation is to methodically explore and systemically solve the barriers with the participants, to elaborate qualitatively how various barriers are solved or circumvented, and to draw attention to the resisting factors faced by the participants and the change agents. My personal motivation for this dissertation is positioned within the field of ICT for development (ICT4D). I was prompted by the barriers I observed in the telecenters and experienced in secondary educational institutions in rural Bangladesh. With these experiences, when I undertook this project to facilitate rural schools to adopt ICT, the inquiries of the participants eventually centered this study within the discipline of educational technology. My educational background in computer science, interest in the field of education, research experience in educational technology or e-learning, and research interest in ICT adoption in rural schools were weaved into the investigation of the diffusion of ICT in secondary educational institutions in a rural context. Therefore, this dissertation contributes to the cross-disciplinary fields of ICT4D, more narrowly within educational technology, and particularly in ICT in secondary education.

In the following, I begin with my personal motivation in relation to the field of research and the methodologies of this dissertation.

Having been born and raised in the capital city of Dhaka in Bangladesh, I was fortunate to have a life in the upper-middle socio-economic class and learn from a strongly tied network of families and friends. My status in the social system allowed me to explore the technological innovations that my friends and relatives from rich families experimented with and to facilitate technology adoption in my social network from disadvantaged urban and rural areas. In addition, from my roles as student, student employee for IT and administration, teaching assistant, IT services staff, and lecturer at a private university—with most of the students and teachers from well-off families—I witnessed and experienced the barriers to using and adopting high-end ICT resources. In 2007, I started facilitating the teachers and students of rural schools to adopt ICT in relation to educational and other personal needs. Eventually, I came to realize the dearth of understanding about the complexities of the barriers in rural areas. I tried to find solution from Non-Governmental Organizations' (NGO) development projects and from software companies that develop content. I was neither very convinced about the strategic programs nor found a knowledge environment that could help me to develop research inquiries. While I was looking for

further opportunities for research and development in the relation to ICT in rural secondary education, I also facilitated web-based learning management systems in the engineering faculty at the university. Eventually, this also could not be sustained after the change in my job role. Thus, I feel that the skills I developed through my computer science degrees not only gives me ability to understand technological advancements but also requires me to facilitate people to overcome the barriers they face to adopt the technology. Facilitating such adoption appeared to be a greater challenge than the advancement of educational technology. Thus, I decided to conduct e-learning or educational technology research as a humanities researcher and not as a computer scientist. Then, I had to choose between secondary and higher education systems. I chose the secondary educational system because I felt that, although rural secondary educational institutions are higher in number and struggle with diverse challenges, yet more research studies have dealt with tertiary education or urban areas. I had also experienced that, in rural secondary educational institutions, my skills and services achieved higher recognition, more flexibility for experimentation were allowed, and my socio-economic status drew more attention from the stakeholders (teachers, students, staff members, parents, and their families). Moreover, the social networks within and around a rural secondary school are more strongly tied and involve less hierarchical classes than the higher educational institutes. Furthermore, the government's policies and strategies toward the achievement of "Vision 2021: Digital Bangladesh" (A2I: PMO, 2009) for the development of and training on ICT in education gave me a firm ground to follow my motivation. Therefore, I took these lessons as inspiration to live near and work in rural secondary educational institutions to share my research experiences and facilitate change toward the sustainable adoption of ICT in education. Thus, I decided to return to live near and work with the same private technical vocational education and training (TVET) institution where I had voluntarily worked earlier—the Tofail Ali Technical School and College (TTSC)—in the village Khagatua of Nabinagar Upazila in the Brahmanbaria district (Khalid & Nyvang, 2013). Later, the junior section of TTSC that includes classes six to eight became involved in this project, and the scope of the research then covered the broad secondary education level of Bangladesh (that is, classes six to twelve).

The first paper in the second part of this dissertation was the plan for this research project, and it adopted a point of departure by arguing that TVET institutions demand a higher priority among secondary educational institutions (Khalid, 2011, p. 2). The underlying reasons include the fact that establishing TVET institutions in Bangladesh requires the offering of prerequisite compulsory computer courses, vocational disciplines in relation to computers, positions for computer teachers, and computer laboratories. It was assumed that the students and teachers have a positive attitude toward technical education, which includes education on computers and other ICT. During this project, the government's new policies and strategies made it compulsory for all secondary schools to teach computer courses, to engage in administrative communication by using Internet-based systems, and to encourage the use of ICT in teaching and learning activities. For instance, the results of state tests and various kinds of educational information became accessible only on the Internet. Therefore, considering the scope of the contribution of this dissertation, the planned title (cf. paper I) was changed from "TVET Institution" to "Secondary Educational Institutions."

The first paper also argues for conducting an action research study that qualitatively investigates the central question: "Due to various barriers, the challenge is how much ICT can be put into practice using school-based telecenters" (Khalid, 2011, p. 1128). This essentially covers the problem statement—

schools in rural Bangladesh face various barriers that fundamentally impede the integration and adoption of ICT in educational contexts, such as lack of electricity, lack of access to ICT, gaps and biases among social classes and genders, resistance from families, etc. The inquiry also focuses on the diffusion of the practice of ICT through school-based telecenters. Furthermore, it was assumed that, if the students, teachers, and staff can be facilitated to integrate and adopt ICT into their practices, then the surrounding community will get support from these new ICT practitioners, and access to resources can be made available at the school as a telecenter. Therefore, the intention was to facilitate ICT adoption in curricular and extracurricular activities, non-formal and informal learning environments, and the school's administrative activities and to establish a telecenter to facilitate the process for the students and for the community. However, when the stakeholders of the study institutions were involved, the problem statement became "students are not acquiring computer and Internet-related vocational and practical skills from the institute" (Khalid & Nyvang, 2013, p. 118). Therefore, the primary agenda became to explore and solve or circumvent the barriers of integrating and adopting ICT in relation to the learning environments of students and teachers. Thus, my initial agenda concerning a school-based telecenter became a hidden agenda and a secondary priority. Against this backdrop, I will now build on educational technology literature to establish the motivation for this dissertation.

ICT in education, predominantly on computers and the Internet, is a multidisciplinary field that has inherent prospects and problems, similar to any other innovation (Aduwa-Ogiegbaen & Iyamu, 2005; Bingimlas, 2009; Khan, Hasan, & Clement, 2012; Plomp, Anderson, Law, & Quale, 2003; Pouezevara & Khan, 2007). Ample evidence has demonstrated that ICT application benefits the learning processes, learners, and learning environments, including disadvantaged communities in third world countries (Cilesiz, 2008; Livingstone, 2012). Despite some controversies regarding the impact of ICT on learning outcomes, practitioners and policymakers are strongly positive concerning the possibilities of the educational technology sector in developing countries, and large-scale investments are being made (Tolani-Brown, McCormac, & Zimmermann, 2010). However, realizing the desired level of positive outcomes and benefits from these initiatives and interventions has remained far-fetched due to various barriers in the process of integrating and adopting ICT in the learning environment (Bingimlas, 2009; Hew & Brush, 2006; Khan et al., 2012; Newby, Hite, Hite, & Mugimu, 2012). For more than thirty years, the barriers to ICT integration and adoption in learning environments has been researched by scholars in the disciplines of education, computer science, information technology, psychology, and many others (Ertmer, 1999; Pelgrum, 2001; Cilesiz, 2008; Law, Pelgrum, Plomp, & International Association for the Evaluation of Educational Achievement, 2008; Ertmer, Ottenbreit-Leftwich, Sadik, Sendurur, & Sendurur, 2012). Moreover, the effective and efficient use of technologies is deeply rooted in why people choose to use a technology and the local needs, values, and norms (Nardi & O'Day, 2000). Therefore, to understand the problems and to facilitate people's use of ICT according to the local needs in relation to the learning environments, there is a strong need to conduct qualitative research in situated contexts. Hew and Brush (2006) made this need explicit in their concluding remarks on their review of 48 empirical research studies on ICT integration in K-12 education: "The quality of past research studies on technology integration appeared to have one or more of the following four main limitations: (a) incomplete description of methodology, (b) reliance on self-reported data, (c) short-term in duration, and (d) focus primarily on the teacher and what went on in the classroom" (p. 246). Therefore, this dissertation departs from the work of Hew and Brush (2006), who suggested that, to

address the methodological limitations, future research on technology integration should build on mixed-methods research, which is characterized as “the class of research where the researcher mixes or combines quantitative and qualitative research techniques, methods, approaches, concepts or language in a single study” (Johnson & Onwuegbuzie, 2004, p. 17). Hew and Brush (2006) also identified and suggested four specific features of mixed-methods research. First, educational technology studies should include an extensive description of the methodology, comprising the length of the study, the number of participants, and inter- and intra-observer agreement reliability. Second, studies should observe the actual practice of teachers and not just rely on self-reported (that is, interview and survey) data. Third, studies should be longitudinal, lasting for more than two years. Fourth, future studies should include mixed methods to examine the decision-making of both internal (i.e., school administrators, leaders, staff members, and students) and external (i.e., decision-makers outside the school) stakeholders that are necessary for technology integration in a school. These features are considered as part of facilitating the schools’ stakeholders to adopt ICT through the methods of diffusion and data collection. These features also contribute to the roles of both the interventionist agent and the researcher. In the process, this dissertation attempts to contribute to three research aspects in educational technology research. First, it attempts to provide an enriched understanding of the barriers to ICT adoption in secondary schools in a situated context. Second, this attempt to circumvent the barriers involves strategic approaches undertaken through participatory inquiry as part of action research. Third, the adoption of the mixed-methods approach known as participatory rural appraisal (PRA) under the umbrella of participatory learning and action (PLA) (Chambers, 2007; Mukherjee & Chambers, 2004; Mukherjee, 2010) is applied in relation to the contexts of the educational stakeholders.

This study was conducted in Bangladesh for three reasons (discussed in detail in paper **III** and covered in papers **IV-VIII**). First, this project builds on the researcher’s former experience in field-based ICT integration facilitation and PRA methods. Therefore, the intention was to demonstrate and propound the adoption of PLA methods in addressing the ICT adoption barriers in the field of educational technology. Second,

As ICT is a relatively new field in the Bangladesh education systems, more in-depth research should be conducted related to the integration of ICT into classroom situations.... (Khan et al., 2012, p. 74)

Therefore, this study took motivation from the political will and evolving strategies for ICT interventions and contributes by understanding barriers to adopting ICT in secondary educational institutions (cf. **Chapters 2-3**). Finally, this study attempts to circumvent the barriers to ICT adoption in educational contexts through in situ facilitation. The research outcomes of this attempt draw attention to the disadvantaged conditions and associated resistances in relation to ICT adoption in rural private secondary schools, which constitute about three-fourths of the total secondary schools in Bangladesh (cf. paper **III**).

1.2. The Case Domain and the Study Institutions

1.2.1. The Case Domain: Secondary Education in Bangladesh and ICT

In this section I will briefly discuss Bangladesh and its secondary education system, which is the broad context of this research endeavor. Then, I will discuss the rural secondary educational institutions involved in this research, describe these institutions, and determine whether one should consider them as typical or atypical in the Bangladeshi context. My underlying intention is to present some elements that will highlight the significance of rural secondary schools in Bangladesh, which are the domain of this research within the education technology field.

Bangladesh has a population of about 142,319,000—98.5% of whom live in one of the 32,067,700 houses. The country has an average annual growth rate of 1.34% (2001–11). There are 71,255 thousand males and 71,064 thousand females, yielding a sex ratio (number of males per 100 females) of 100.3. There is an average of 964 inhabitants/sq. km (one of the highest in the world), while in the Dhaka district, there are 8,111 inhabitants/sq. km, and 4.4 persons per household (BBS, 2011). Bangladesh has a total land area of 147,570 sq. km., containing an effective land area of 119,624 sq. km. In comparison, the land area of Denmark (43,094 sq. km) is less than one-third of Bangladesh, but the population of Bangladesh is more than 25 times greater than that of Denmark (5,543,453) (CIA, 2012). In 2005–06, there were 49.5 million civilian laborers (age 15+), 45.07% of the employed population were involved in agriculture, 11.03% in manufacturing, and 40.3% in other sectors (Bangladesh Bureau of Statistics, 2011). The per capita income in 2009–10 was 751 USD, or 51,945 Bangladesh Taka (BDT). In October 2013, the inflation rate was 7.03 and the consumer price index was 1947.01 (BBS, 2013). In 2009, the literacy rate (7+) was 59.6% for males, 53.8% for females, and 56.7% for both sexes; the adult literacy rate (15+) was 62.6% for males, 54.3% for females, and 58.4% for both sexes (Bangladesh Bureau of Statistics, 2011).

About 72% of the inhabitants live in rural areas (World Bank, 2012). Presumably, the number of educational institutes and the number of students in rural areas constitute the greatest proportion.

The Bangladesh Bureau of Educational Information and Statistics (BANBEIS) is a public agency that provides overall statistical and quality assessment reports for the two educational ministries. Primary and mass education are governed by the Ministry of Primary and Mass Education (MOPME), while secondary and higher education are governed by the Ministry of Education (MOE). According to BANBEIS, the present education system in Bangladesh can be broadly divided into three major stages: primary, secondary, and tertiary education (as shown in Figure 1.1). Operationally, the education system is categorized into two stages: primary education (Grades I–V), managed by the MOPME, and post-primary education (Grades VI and above), which covers all other levels, from junior secondary to higher education, and is under the administration of the MOE. In terms of curriculum, post-primary education is further classified into four types: general education, madrasah education, technical-vocational education, and professional education (see Figure 1.1). There are three types of secondary educational institutions: schools and colleges, madrasahs, and technical and vocational institutions.

Age (Year)	Grade	Main stream										Madrasa stream	English medium stream										
		General		Professional		Technical-vocational																	
26+	21	PhD		MD, PhD		PhD	Post graduate	Post graduate						Post Kamil studies	PhD								
25+	20																						
24+	19																						
23+	18	MPhil		MPEd, MEd	MPhil Dip	MS, MPhil	BSc in Engr	BSc in Tech. Ed	BSc in Health Technology					Kamil	Masters								
22+	17																						
21+	16																						
20+	15	Bachelor (Pass)	Masters (Prel.)	BP Ed, B Ed	LLM	MBBS BDS BSc in Nursing Science and Midwifery	MS, MSc in Engr, Ag	BSc in Engr, Ag, Text, Leather	Comp	Dip in Tech Ed				Fazil	3 year degree course								
19+	14																						
18+	13																						
17+	12	Secondary	Higher secondary examinations (grade 12)										NSS master	Alim	A level								
16+	11		HSC (Voc) Alim (Voc)		HSC (General) Alim (Madrasah) HSC (BM) Diploma in Com. A level (English)											Diploma in Engr., Alct, Text., Glass & Ceramics, Survey, Printing Marine Engr, Graphic Arts, Ag.	Dip in Forestry	Certificate in Survey	Dip in Health Technology	Medical assistant	Junior midwife	Computer trng Cert in Voc Ed Dip in Voc Ed	NSS I
15+	10																						
14+	9	SSC (voc) Dakhil (voc) SSC (voc- textile)											SSC (general) Dakhil (madrasah) O level (English)										
13+	8																						
12+	7																						
11+	6	JUNIOR SECONDARY EDUCATION (grade 8)										Open	Dakhil	O level									
10+	5																						
9+	4																						
8+	3	PRIMARY EDUCATION (grade 5)										Open	Ebtedayee	Standard									
7+	2																						
6+	1																						
5+		PRE-PRIMARY EDUCATION, EARLY CHILDHOOD EDUCATION, HOME TUTORING										Maktab	Nursery										

Figure 1.1 *The Education System in Bangladesh* (Source: BANBEIS, 2010)

BANBEIS (2010) summarized the secondary education system as follows:

The second level of education is comprised of 7 (3+2+2) years of formal schooling. The first 3 years (grades VI-VIII) is referred to as junior secondary; the next 2 years (grades IX-X) is secondary while the last 2 years (grades XI-XII) is called higher secondary.

There is diversification of courses after three years of schooling in junior secondary level. Vocational and technical courses are offered in vocational and trade institute/schools. Moreover, there are high schools where SSC [secondary school certificate] (vocational) courses have been introduced.

In secondary education, there are three streams of courses such as, humanities, science and business education, which start at class IX, where the students are free to choose their course(s) of studies.

High schools are managed either by government or private individuals or organizations. Most of the privately managed secondary schools provide co-education. However, there are many single-sex institutions in secondary level education. The academic programme terminates at the end of class X when students are to appear at the public examination called SSC (secondary school certificate). The Boards of Intermediate and Secondary Educations (BISE) conduct the SSC examination. There are seven such boards at different places in Bangladesh, namely: Dhaka, Rajshahi, Jessore, Comilla, Chittagong, Sylhet, and Barisal.

The secondary education is designed to prepare the students to enter into the higher secondary stage. In [the] higher secondary stage, the course is of two-year duration (XI-XII), [and is] offered by intermediate colleges or by [the] intermediate sections of degree or master colleges.

The educational institutions that follow the nation curriculum to impart teaching at the secondary level (grade 6 to 12) are governed by two public bodies under the MOE: the Directorate of Secondary and Higher Education (DSHE) and the Directorate of Technical Education (DTE). The secondary educational institutions under the DSHE include government and non-government schools, colleges, and madrasahs. Madrasahs (Arabic for “educational institution”) have core courses that are similar to the general stream (primary, secondary, and post-secondary), but put additional emphasis on religious studies. The DTE administers SSC vocational schools, higher secondary certificate (HSC) business management colleges, basic trade courses to linked schools under the DSHE, and self-supported private skill development training centers. Autonomous and statutory boards under these directorates administer academic activities, affiliations, curricula, and examinations. The Bangladesh Technical Education Board (BTEB) is the only statutory board under the DTE. On the contrary, the Bangladesh Madrasah Education Board and eight other regional boards for intermediate and secondary education are under the DSHE.

It is important to note that the BANBEIS provides statistics for institutions that are affiliated with the national curricula only, and it does not provide a holistic picture of all secondary education in Bangladesh. For instance, English medium schools and Qawmi madrasahs are not affiliated with any public body. The BANBEIS has never conducted a census on the academic institutions that have external and non-public affiliations (BANBEIS, 2011b). There are around 200,000 teachers and approximately 4,000,000 students in about 15,000 Qawmi madrasahs (The Daily Star, 2009). The first and only special survey identified a total of more than 58,000 students at the secondary education level in 159 English medium schools (BANBEIS, 2011b). These educational institutes constitute a significant portion of the education system and contribute heavily to the development of Bangladesh. However, Digital Bangladesh initiatives directly contribute to the transformation of the parts of the Bangladeshi secondary education systems that are affiliated with the DSHE and the DTE. So, broadly, the case institutions of this dissertation belong to the secondary educational institutions that are under the affiliated processes of the two public bodies—the DSHE and the DTE.

A statistical overview of the secondary education system can involve the categorization of institutions and their members according to education type, management type, and location. Table 1.1 presents the frequency and percent relative frequencies of students by different types of institutions and by institutions' management. There are more than 11.5 million students in secondary education, which constitutes more than 84% of the student population of Bangladesh. Among the total population of students, 47% are in the junior secondary grades, 23% are in the secondary grades, and 14% are in the higher secondary grades (BANBEIS, 2011d).

Table 1.1 *Number of Students by Levels of Secondary Education and Management, 2011*

Type of education	Management	Junior secondary: 6–8 grades (% Total)	Secondary: 9–10 grades (% Total)	Higher secondary: 11–12 grades (% Total)	Total (% Total)
School	Public	143,912 (1.25)	84,330 (00.73)	-	228,242 (1.98)
	Private	5,105,778 (44.23)	2,176,198 (18.85)	-	7,281,976 (63.08)
	Total	5,249,690 (45.48)	2,260,528 (19.58)	-	7,510,218 (65.06)
College	Public	-	-	308,289 (2.67)	308,289 (2.67)
	Private	-	-	1,285,329 (11.14)	1,285,329 (11.14)
	Total	-	-	1,593,618 (13.81)	1,593,618 (13.81)
Madrasah	Public	343 (0.00)	519 (00.00)	393 (0.003)	1,255 (0.01)
	Private	1,282,611 (11.11)	601,643 (5.21)	189,555 (1.64)	2,073,809 (17.97)
	Total	1,282,954 (11.11)	602,162 (5.22)	189,948 (1.65)	2,075,064 (17.98)
Technical and vocational	Public	-	24,111 (0.21)	39,318 (0.34)	63,429 (0.55)
	Private	-	226,180 (1.96)	74,455 (0.64)	300,635 (2.60)
	Total	-	250,291 (2.17)	113,773 (0.98)	364,064 (3.15)
Country	Public	144,255 (1.25)	108,960 (0.94)	348,000 (3.02)	601,215 (5.21)
	Private	6,388,389 (55.34)	3,004,021 (26.03)	1,549,339 (13.42)	10,941,749 (94.79)
	Total	6,532,644 (56.59)	3,112,981 (26.97)	1,897,339 (16.44)	11,542,964 (100.00)

Source: Adapted from BANBEIS (2011d)

Table 1.1 shows that about 95% of students belong to a private institution, around 60% are in the junior secondary grades, and about 44% are in the junior secondary grades of private schools. There are 2,989 private junior secondary schools in the country, with a 1:20 teacher-student ratio (TSR), 149 students per institution (SPI), and 7 teachers per institution (TPI) (BANBEIS, 2011a).

The percentages of female students in secondary education level are as follows: about 55% in the junior secondary grades, more than 50% in the secondary grades, and more than 48% in the higher secondary grades.

Technical and vocational education and training (TVET) institutions host 3.15% of the students in secondary education, and about 83% of the students in vocational institutions come from private institutions (see Table 1.1). About 86% of the technical and vocational institutions (including technical schools and colleges, SSC vocational—independent and attached, HSC vocational (HSC Voc)/business management (BM)—independent and attached) are part of the secondary education level (BANBEIS, 2011d). Of 2,981 TVET institutes, 2,730 are private, and they employ about 80% of teachers and train more than 70% of technical students (BANBEIS, 2012). The private technical and vocational institutions of the country have a 1:19 TSR, 131 SPI, and a 6.8 TPI (BANBEIS, 2011c). Only 20% of the teachers and 27% of the students are female (BANBEIS, 2011e).

More than 84% (15,785 of 18,756) of the secondary schools are located in rural areas (BANBEIS, 2008), and more than 55% of the TVET institutes are situated in rural areas (BANBEIS, 2011f). It is, therefore, a fact that the greater proportion of secondary and higher secondary institutions in Bangladesh are situated in rural areas, which are more disadvantaged and prone to greater barriers to the adoption of information and communications technology (ICT).

The Ministry of Education, through the DSHE and the DTE, introduced a pay scale for the teachers and employees of non-government schools, colleges, technical and vocational institutions, and madrasahs. The government pays 100% of the salaries (called a monthly payment order, or MPO) of the full-time employees, but there are challenges associated with finding eligible candidates. Each of these non-government secondary educational institutions is privately responsible for any expenses relating to infrastructure, operations, maintenance, and salaries of any ad-hoc or part-time employees. Non-government secondary educational institutions are managed by a “managing committee” and government secondary and higher secondary institutions are managed by a school management committee (SMS) or governing body (Intermediate and Secondary Education Boards, Bangladesh, 2006; DSHE, 2013). These management bodies comprise of local dignitaries, teacher representatives, guardians, and local officers of the DSHE.

The Non-Government Teachers’ Registration and Certification Authority (NTRCA) conducts registration examinations to certify teachers’ eligibility to seek MPO, then appointed through a non-government secondary educational institution and approved by the DSHE or the DTE.

The National Curriculum and Textbook Board formulates the curricula and publishes all textbooks for secondary educational institutions under different education directorates and boards.

Bangladesh is possibly the most notable country in the Asia Pacific region with regards to the increasing deployment of ICT in education, particularly with the “Vision 2021: Digital Bangladesh” nation-branding/scheme of 2009 (Akhtar & Arinto, 2009). The scheme has six strategic areas focused on facilitating the adoption of ICT in education: general and TVET education systems, professional development of teachers using ICT, education-related citizen services, ICT literacy for students, ICT infrastructure and delivery channels, and ICT in educational administration (A2I: PMO, 2009). To work

toward these strategic objectives, orchestrated and sporadic initiatives have been undertaken by national and international, public and private, collective and individual, and business and non-profit entities (A2I, 2013).

Bangladesh's secondary education system underwent a significant transformation during 2009–13, in relation to the integration and adoption of ICT (MoE, 2013). All educational ministries, directorates, boards, and institutions developed or were provided with online platforms to ensure access to information. The results from the education boards and NTRCA were made accessible online. Web applications for examination administration, i.e. registration, marks submission, etc., were made compulsory. Each educational institution was provided with an administrative email account for required communications with education boards and directorates. Paper-based notices from the directorates and education boards were discontinued; notices are now posted on websites, and in some cases, these notices are sent through emails. All textbooks for the primary and secondary levels were made available online. ICT and computer subjects were made compulsory for different classes in secondary education. Through various projects, multimedia contents are being developed, multimedia classrooms are being introduced by providing resources and training, and teachers are being introduced to blogs and social networking platforms. This list of educational technology initiatives can be very broad, as a significant number of projects and transformation processes have been initiated by public and private entities. However, it is not possible to find any summary or broad overview of the recent and rapid implementations of ICT in education projects.

1.2.2. The Case Domain: Tofail Ali Technical School and College

In order to conduct an action research study, it was necessary to come to an early agreement with an institution's management body. Considering my former ICT integration and diffusion initiatives with Tofail Ali Technical School and College (TTSC), the managing committee approved me to undertake a research project from the perspective of a consultant and voluntary development practitioner.

TTSC is situated in the village of Khagatua, under Ratanpur Union Parishad, of Nabinagarupazila, Brahmanbaria district, in the Chittagong division of Bangladesh. In 2001, TTSC became affiliated with the BTEB, and MPOs for teachers and staff were approved by the DTE. In the same year, SSC Voc students were admitted and TTSC began operating. From the next year, HSC BM and basic trade courses were initiated. In 2003, Tofail Ali Kindergarten was established to address the lack of junior secondary schools in neighboring villages and to improve the quality of students joining TTSC. In 2009, a pre-school section was established as part of the kindergarten, which comprised of playgroup and nursery classes. In 2012, grade 1 and 2 were established in the kindergarten. In 2010, junior school certificate (JSC) was introduced as a state test, and it became necessary to gain affiliation for the junior secondary grades. Subsequently, in 2012, the junior secondary grades were registered as a junior secondary school under the name Tofail Ali Technical School and College, under the Comilla board. However, the DSHE did not approve the MPOs. All of these institutions were founded by Md. Muzahed Ali, who donated ancestral land in the village and a significant proportion of the funding, and contributed his vast experience as a public officer of the DTE, a curriculum specialist, and a TVET consultant (he retired in 2008). TTSC's junior secondary section and the technical and vocational institution have separate management bodies, with the same individuals in both. Currently, the two

managing committees are chaired by a deputy secretary of the Ministry of Home Affairs. TTSC can be broadly categorized as a typical secondary educational institution, which is private and rural. However, in terms of the diversity of the administrative processes associated with the different curricula and institutional systems, TTSC is not very typical. Only 2.6% of the secondary education students go to the private technical and vocation institution at TTSC. On the contrary, 44.23% of the secondary education students go to the junior secondary grades of private schools.

TTSC's technical and vocational section (grades 9 to 12) includes two different curricula and institutional systems in one, which is a combination of one independent SSC vocational school and one independent HSC BM college. As opposed to the independent and separate institutions, TTSC being combined (i.e. SSC and HSC) and independent creates challenges in securing MPO approval for non-academic positions. For instance, for SSC vocational administration, TTSC's office assistant/accounts assistant position became vacant in 2011. Later, an MPO for that position was denied and the application processing officer argued that one office assistant per institution should be sufficient. In addition to the SSC Voc and HSC BM institutions, TTSC is authorized by the DTE to function as a professional training institution, which can offer four basic trade courses. However, currently TTSC cannot offer the basic trade courses, primarily due to a lack of trade teachers.

Table 1.2 shows the population of students in TTSC by grade, vocational/business management trade, and sex. It was found that the students come from 11 different villages. About 53% (173 out of 325) of the students are female, and 51% (34 out of 67) of the students in the computer trade are female. Among the four trades in SSC Voc, the computer trade is studied by 40% students (34 out of 86). Among the two trades in HSC BM, the computer trade is studied by 59% students (33 out of 56).

Table 1.2 *Student Statistics of TTSC in 2011*

Institutions	Grade	Male	Female	Total
Tofail Ali Technical School and College (junior secondary section, under Comilla Board and the DSHE)	6	15	39	54
	7	19	32	51
	8	25	25	50
	Sub-total	59	86	155
Tofail Ali Technical School and College (under the BTEB and the DTE)	9 (4 trades)	20	27	47
	Computer & information technology	08	11	19
	Poultry rearing and farming	05	04	09
	Dressmaking and tailoring	-	12	12
	General electrical works	07		07
	10 (4 trades)	25	22	47
	Computer & information technology	06	09	15
	Poultry rearing and farming	09	-	09
	Dressmaking and tailoring	-	13	13
	General electrical works	10	-	10
	11 (2 trades)	23	16	39
	Accounting	13	10	23
	Computer	10	06	16
	12 (2 trades)	25	12	37
	Accounting	16	04	20
	Computer	09	08	17
	Sub-total	93	77	170
	TOTAL	152	173	325

Source: Primary data, 2011.

Table 1.3 *Employee Statistics of the SSC Voc and HSC BM sections of TTSC in 2011*

Higher Secondary Certificate in Business Management (HSC BM)					
Sl	Designation	Positions	Employed	Vacant	Qualifications (2013)
1	Principal	1	1	-	2 nd class in master with a 2 nd class in bachelor, 12 years of experience as a lecturer
2	Lecturer (computer operation)	1	-	1	B.Sc.Eng. in computers or M.Sc. (physics, mathematics, chemistry, statistics, management, and accounting) with computer training and NTRCA registered
3	Lecturer (accounting)	1	1	-	2 nd class in master with bachelor in the subject (accounting) and NTRCA registered
4	Lecturer (Bengali)	1	-	1	2 nd class in master with bachelor in the subject (Bengali) and NTRCA registered
5	Lecturer (English)	1	-	1	2 nd class in master with bachelor in the subject (English) and NTRCA registered
6	Lecturer (management)	1	1	-	2 nd class in master with bachelor in the subject (management) and NTRCA registered
7	Computer demonstrator	2	2	-	Diploma in engineering (computer)
8	Office assistant/ accounts assistant	1	1	-	HSC (commerce/BM) and proficient in operating a computer
9	Lab assistant	1	1	-	HSC (vocational)
10	Member of lower supporting staff (MLSS)	1	1	-	8 th Grade
TOTAL		11	8	3	
Secondary School Certificate in Vocational Trades (SSC Voc)					
Sl	Designation	Positions	Employed	Vacant	Minimum Qualifications
1	Assistant teacher (language)	1	1	-	B.A. (Bengali/English) and NTRCA registration
2	Assistant teacher (mathematics)	1	1	-	B.Sc. (mathematics) and NTRCA registration
3	Assistant teacher (science)	1	-	1	B.Sc. (physics or chemistry) and NTRCA registration
Trade instructors					
4	Computer & information technology	2	-	2	Diploma in engineering in the associated subject and NTRCA registration
5	General electrical works	2	1	1	
6	General mechanics	2	-	2	
7	Dressmaking and tailoring	2	-	2	
8	Poultry rearing and farming	2	-	2	
9	Refrigeration and air-conditioning	2	-	2	
10	General electronics	2	-	2	
11	Computer demonstrator/mechanic	1	-	1	Diploma in engineering (computer) or BSc/BCom with minimum six months computer training.
12	Lab assistant	2	2*	-	HSC (voc/BM)
13	Science lab assistant	1	1	-	SSC (voc/science/equivalent)
14	MLSS	1	1	-	8 th grade
TOTAL		27	7	16	

Source: Primary data, 2011. *One of the lab assistants is not covered by an MPO.

Table 1.3 shows the number of employees in the SSC Voc and HSC BM sections of TTSC by designations, MPO-eligible positions, qualifications, and vacancies; 50% (19 out of 38) of the positions are vacant. In HSC BM, 5 of the 8 teaching positions are occupied, and in the SSC Voc, only 6 of the 21 teaching positions are occupied. Computed TSRs for the SSC Voc and HSC BM sections are 1:31 and 1:28, respectively. Considering that the average SPI for TVET institutions in Bangladesh is 131, TTSC has an above-average SPI. Contrarily, with the country's average TPI being 6.8, TTSC has a below-average TPI.

Table 1.4 *Required Teachers and Staff of the Junior Secondary Section of TTSC (2013)*

Sl	Designation	Positions	Qualifications (2013)
11	Headmaster	1	Master of arts (M.A.)/master of science (M.Sc.), master of education (M.Ed.), experience, and NTRCA registration
22	Assistant teacher (mathematics and general science)	1	B.Sc. (mathematics/physics), bachelor of education (B.Ed.), and NTRCA registration
33	Assistant teacher (social science)	1	Bachelor degree in any subject, B.Ed., and NTRCA registration
44	Assistant teacher (agriculture)	1	Diploma in agriculture and NTRCA registration
55	Assistant teacher (religion – Islam)	1	Fajil and TRCA registration
66	Assistant teacher (religion – Hinduism)	1	B.Ed. and NTRCA registration
77	Assistant teacher (computer)	1	Bachelor/equivalent degree in computer engineering or three-year diploma in computer science, B.Ed., and NTRCA registration
88	Assistant teacher (physical exercise)	1	B.A., bachelor of physical education (B.P.Ed.), and NTRCA registration
99	Office assistant/ computer operator	1	HSC (commerce) and proficient in operating a computer
110	MLSS	1	8th Grade

Source: Primary data, 2013

The junior secondary school section of TTSC was officially affiliated with the Comilla board from 1st January, 2012. The board approved the affiliation under two conditions: First, given the needs of the people in the vicinity, the school would be affiliated, but financial support (i.e. MPOs for the employees) would not be provided. Second, the existing teachers of the SSC Voc and the HSC BM would share the teaching load and the school would bear all associated costs in relation to the employment of teachers or otherwise. Table 1.4 shows that for the junior secondary section of TTSC there is an additional workload for eight teachers and two assistant staff members. The irony is that while the existing TPIs of TTSC's vocational and BM sections are below average, the community's need for accessible education gets priority over the school's or the nation's education quality achievement objectives. Moreover, while Bangladesh's government's intention was to improve the quality of education through the introduction of JSC examinations, the overhead costs of affiliation and examination administration turned into enforced liabilities for the schools' management, teachers, and parents. As a result, the introduction of the JSC examination process and the subsequent affiliation of TTSC with the education board caused additional administrative workload and costs, instead of providing job security to teachers and financial support to the intuition. TTSC's MPO-registered teachers took on the additional teaching load for this junior section, and only three full-time teachers

could be employed for the subjects Islam, Hinduism, and science. Apart from these three teachers, for extra-curricular activities a part-time music teacher is also employed for the whole of TTSC. Given this scenario, it would be incorrect and inappropriate to compute the TSR and TPI for this section of TTSC. However, the information given sufficiently indicates the disadvantages present. Considering the country average of 149 students per private junior secondary school, TTSC has a typical student population.

There is a lack of statistical data to illustrate the differences between rural and urban schools. For instance, the TSRs of rural schools are not available. A comparison of TTSC with the national average for rural institutions would have given more appropriate insight into the context. Moreover, the statistics for different types of institutions also vary significantly, and such differences can certainly be expected for rural and urban institutions. Therefore, due to the lack of sufficient statistics, it is not possible to determine whether TTSC is a typical or atypical rural private secondary educational institution.

The cost of education and cost of living are two important aspects that give a better understanding of an educational institution's context. On December 3, 2013, Bangladesh Bank, the central Bank of Bangladesh, showed the following buying rate: 1 USD for 77.75 Bangladeshi Taka (BDT, symbol ৳) and 1 EUR for 105.6545 Taka. At the same time, students' monthly school fees (in BDT) were as follows: 6th grade cost $\text{৳}50$, 7th grade cost $\text{৳}60$, 8th grade cost $\text{৳}70$, 9th grade cost $\text{৳}80$, 10th grade cost $\text{৳}90$, 11th grade cost $\text{৳}120$, and 12th grade cost $\text{৳}150$. So, the highest monthly tuition fee of a student was less than 2 USD, or 1.5 EUR. According to government regulations, from 6th to 10th grade, about 30% of female students and 10% of male students study for free. The subsidy is lower than TTSC's expected total from tuition fees. In addition to the implementation of government policy on tuition, about 20% of students have their tuition fees waived due to their need for financial support. About 40% of female students in the 11th and 12th grades are exempted from paying tuition fees. Yearly admission and various other fees are also relatively inexpensive. For instance, an SSC vocational (e.g. 9th grade) admission form costs 120 (the institution gets 80 and the rest is transferred to a public fund), registration costs $\text{৳}222$ per student, and the exam fee is $\text{৳}1,250$. The examination fee includes the board fee, center fee, practical center fee, practical fee, industrial attachment fee, mark sheet fee, and certificate fee. The institution gets a portion of the examination fee for the examination processes and the rest is transferred to the board's account. In the case of HSC BM, in 2013, the registration cost was $\text{৳}280$ per student, and the examination fee was $\text{৳}1,350$. For the JSC examination registration each student had to pay $\text{৳}80$. TTSC's only major income source is the tuition fees. The administrative overhead (such as drafting, printing, and making copies of documents) in relation to the admission and registration is higher than the amount received from the fees. So, TTSC has to allocate additional funds to carry out the education board's administrative process. TTSC pays various affiliation fees to the education boards: $\text{৳}1,500$ per year per HSC BM trade (total $\text{৳}3,000$), $\text{৳}1,250$ per year for each of the 7 SSC Voc trades (total $\text{৳}8,750$), and $\text{৳}5000$ for three years of JSC affiliation. After paying the salaries of the part-time teachers and staff, there is little left in the account.

In the rural areas, the cost of living is much higher than educational expenses. For instance, in Khagatua village, to take a passport-sized picture for an admission form or buy educational resources, one has to go to another village's market, spending at least $\text{৳}30$ for conveyance. One liter of milk costs

₹40–60, one kilogram of rice costs ₹20–40, one kilogram of chicken costs ₹125–180, an egg costs ₹6–7, and one kilogram of sweets costs ₹120–220. At a restaurant it typically costs ₹20–30 for breakfast, ₹50–100 for lunch, ₹15–20 for a late-afternoon snack, and dinner costs about the same as lunch. One liter of bottled drinking water costs ₹10–15. So, the monthly tuition fee for a student is equivalent to the market price of 5–12 bottles of pure drinking water.

The building structures and resources of TTSC have gone through significant changes during the project. At the beginning of this project, the school premise included four single-storied structures, located on one piece of rented land and one piece of owned land. Upon entering the rented rectangular courtyard, which is less than the size of two badminton courts, one would be standing under a canopy formed by large old trees, surrounded by an L-shaped section of bamboo fence and tin roof, one brick-cement structure with two rooms in very bad condition, and one partly bamboo, partly tin fence structure with a tin roof; except for the brick-cement structure, the buildings have mud floors. TTSC's own land is adjacent to the leased land. On the owned land, a new structure with brick-cement walls, a tin roof, and a cement floor was still under construction. Three of the five rooms were being used as computer laboratories (and were also allocated for use in this project), one room was used for 12th grade lessons and for examinations, and the last was the lab, which was used for dress making and tailoring. TTSC has free access to a big household compound with three structures, where two of the structures are used for bachelor teachers' and students' accommodation, and one structure is for poultry farming. The principal's house is a beautiful compound and is a free housing facility offered by a generous family, who presently stays in the capital and only visits the house during vacation. During the project, new structures were built and parts of the old structures were moved off the leased land, as the lease agreement had matured and the owners initiated construction of a new structure for their family. I believe that my experience with the management, operation, and maintenance of structure resources has the potential to inform the research community about the dire need for fundamental resources—sanitary toilets, safe drinking water, sufficient seating, smooth flooring that does not make writing a challenge, and many others. I can see that the institute is in a continuous struggle for its existence, and it needs to break out of the vicious cycle of funding crises and resource deficiencies. Three stakeholders play a vital role in this struggle: the people involved in the process of founding the institution, their kinsmen, and above all—the teachers. In various ways, the alumni have also begun to tackle the challenges caused by lack of funds and resources.

In terms of ICT resources, in 2010, when TTSC was confirmed for this project, there were two computer labs with a total of five desktops—some with defective components. For management and academic documentation, there was one desktop and one bubble jet printer in the principal's office. A USB modem with EDGE connectivity could not be used due to a lack of technical support. Thus, the Internet was never used in the institution and none of the staff had the chance to use the Internet, except for during teacher training. Lack of trade teachers, particularly computer teachers, has always been a big barrier to appropriate use and maintenance of ICT. Among the students' and teachers' families, computer ownership was rare.

1.3. Structure of the Dissertation

In this section I discuss the proceedings of the dissertation in the course of exploring and circumventing the barriers of integration and adoption of ICT in the secondary educational institutions introduced in the previous section.

The dissertation is comprised of two parts: Part I and Part II. Part I includes four chapters, which introduce the project, discuss the theoretical and methodological approaches, and address the findings from the list of papers presented in Part II. This thesis being from paper-based genre, the findings and experiences were gained in the process of facilitating in the field, reflecting through the papers presented in part II, and compiling part I to provide a comprehensive presentation. Hence, I begin with an overview of part II for conveniently communicating the basis of part I.

Part II of the dissertation consists of eight papers, which are referred to by Roman numerals (**I-VIII**).¹ In addition, future paper 1 (F1) and future paper 2 (F2) refer to two themes of the empirical investigation, and these working papers are not included in this dissertation. It is important to briefly discuss about these two themes as these have a methodological relationship, planned intention and holistic contribution in relation to the diffusion facilitation conducted during the field research in Bangladesh. Paper **I** is the study plan, which covers a broad scope, multiple theories, research methodologies, selection of mixed-methods and possible ways to diffuse ICT. Paper **III** was the second paper that received peer-review comments and demonstrated mixed methods approach called participatory learning and action (PLA), which is also known as participatory rural appraisal (PRA). In paper **III**, analysis of empirically identified barriers to ICT adoption led to the development of a theoretical framework of the barriers to integrate and adopt ICT in secondary education system. Then, in paper **II**, a literature review was conducted on the barriers of integration and adoption of ICT in relation to education. The review conducted in paper **II** also contributed to further development of the plan and other papers. The themes can be broadly divided into formal, non-formal, and informal learning environments. Paper **IV** explored existing practice of ICT in the rural learning context, particularly in the informal context as the presence of ICT in formal and non-formal learning environments had been hardly practiced. The diffusion strategies to facilitate ICT adoption in the formal environment cover four themes: curricular activities (paper **VI**), educational administration (paper **VII**), extracurricular activities (paper **VIII**) and industrial attachment (future paper **F2**). The informal learning environment involves integrated facilitation for the purchase of resources and training (paper **V**). The non-formal learning environment includes the facilitation of implementing a before- and after-school computer literacy center (future paper **F1**). In relation to the discussion in Chapter 2, it is important to inform the research community about other strategic initiatives (as **F1** and **F2**). I present a brief description of **F1** and **F2** in section 1.6 to acknowledge the fact that understanding and solving barriers occur across these strategic activities. Therefore, the inter-connectedness of these factors is significantly complex, which are rooted to participants' needs, literature supported motivation and theoretical foundations.

In part I, Chapter 1 introduces the subject and themes, and the overall purpose is to provide the reader with a broader background before the discussion of specific questions from within and across the

¹ Section 1.6 includes a list of the full titles and publication details for the papers and a brief introduction to the individual texts.

subsequent papers. In Chapter 2, I introduce Rogers' (1995) theory of diffusion of innovations (DoI) as a guide for playing my role as a change agent, discuss a methodical way to understand the barriers, and devise a hybrid diffusion system to solve or circumvent the barriers. Chapter 3 elaborates and combines Rogers' DoI processes for organizational adoption, individual innovation-decision, and the roles of a change agent to devise a mash-up process, which is then used as a basis to develop understanding and to solve the barriers through in-situ facilitation. Moreover, this chapter integrates the application of the hybrid diffusion system through the in situ facilitation research. Furthermore, Chapter 2 and 3 refer to the application of the ethnographic action research (EAR) methodology and participatory learning and action (PLA) method; these prompt readers to find the details in the papers presented in Part II. Finally, Chapter 4 presents a summary of the findings and recommendations.

1.4. Research Questions

The plan for this research (paper I) started with some initial research questions. These questions involved the different learning environments, explored ICT practice and diffusion strategies to facilitate adoption, and evaluated the contribution to livelihood and information ecology. Some of these questions and objectives matched the participatory inquiries and led to the development of research questions for each of the theme-oriented papers.

The participants established the research problems and shaped the formulation of the research questions. The problem statement that paved the way for the development of research questions for this dissertation was:

Students are not acquiring computer and Internet-related vocational and practical skills from the institute. (paper III)

The causes and effects in relation to this problem (paper III) led to an emphasis on the barriers and development of strategies to diffuse ICT while solving or circumventing those barriers. Now, to view this research holistically as I stand today, I consider the participants' inquiries and the research questions in the papers (II-VIII) to devise the central research questions of this dissertation. It is manifested through the papers that the intention was to consider the holistic context of learning in relation to ICT adoption. The questions in these papers also show that this dissertation deals with the barriers to integrating and adopting ICT in the learning environments of the secondary educational stakeholders (particularly, students, teachers, staff members, and management) of rural Bangladesh. The two main research questions of this dissertation are as follows:

1. How can we apply the theory of diffusion of innovations *methodologically* and *methodically* to *understand the barriers* to adopting ICT in the learning environments of the stakeholders of secondary education?
2. How can we apply the theory of diffusion of innovations *strategically* and *systemically* to *circumvent the barriers* to adopting ICT in the learning environments of the stakeholders of secondary education?

This dissertation addresses these questions by:

- Reviewing the barriers to integrating and adopting educational technology (paper **II**)
- Appropriating some of the participatory learning and action methods in the context of educational institutions (paper **III-VIII**) and as mixed methods for educational technology research
- Demonstrating the application of ethnographic action research methodology in diffusion research (paper **VI** and **VIII**)
- Exploring the existing practices of ICT in the learning environments of the teachers and students of rural Bangladesh schools (paper **IV**)
- Elaborating on four diffusion strategies in understanding, solving, and circumventing the barriers to adopting ICT (paper **V-VIII**)
- Devising and Applying a hybrid diffusion system to facilitate organizational and individual adoption of ICT in secondary educational institutions in Bangladesh (Chapter 2 and 3)

1.5. The Research Paradigm, Methodology, and Methods

1.5.1. The Research Paradigm

This dissertation is positioned within the transformative paradigm, which inherits some of the properties of the interpretivist/constructivist paradigm. This standpoint is based on the work of Mackenzie and Knipe (2006), and will be discussed in more detail below.

Interpretivist/constructivist research approaches attempt to understand “the world of human experience” (Cohen & Manion, 1994, p. 36), which posits that “reality is socially constructed” (Mertens, 2005, p. 12). Researchers from the interpretivist/constructivist paradigm tend to rely on the “participants’ views of the situation being studied” (Creswell, 2003, p. 8), and also take their own experiences and background into account. “Constructivists do not generally begin with a theory (as with post-positivists)” (Mackenzie & Knipe, 2006, p. 196); instead, through their research process, they “generate or inductively develop a theory or pattern of meanings” (Creswell, 2003, p. 9).

Transformative researchers feel that the interpretivist/constructivist paradigm has a bias toward males, fails to include marginalized people, and is inadequate in addressing issues of social justice (Creswell, 2003; Mertens, 2005). Transformative researchers “believe that inquiry needs to be intertwined with politics and a political agenda” (Creswell, 2003, p. 9) and contain an action agenda for reform “that may change the lives of the participants, the institutions in which individuals work or live, and the researcher’s life” (Creswell, 2003, pp. 9–10). A mixed-methods approach gives the transformative researcher structure for the development of “more complete and full portraits of our social world through the use of multiple perspectives and lenses” (Somekh & Lewin, 2005, p. 275), allowing for an understanding of “greater diversity of values, stances, and positions” (Somekh & Lewin, 2005, p. 275). These also reflect the methodological suggestion by Hew and Brush (2006), as described in section 1.1.

In the following section, I will briefly discuss the positioning of the methodology and methods of this dissertation, within the transformative paradigm.

In educational research, Donna M. Mertens is one of the pioneers of the transformative paradigm, having established the relationship between the mixed-methods approach, participatory action research, and the transformative paradigm (Mertens, 2003, 2005, 2007, 2010). In “The Context of Educational Research”, the relationship between the transformative paradigm, participatory research, and mixed methods was argued for based on the features of critical theory and the concept of critical education research (Cohen, Manion, & Morrison, 2011). A transformative paradigm has four “basic beliefs” (Cohen et al., 2011, p. 33):

Ontology (the nature of reality or of a phenomenon): politics and interests shape multiple beliefs and values, as these beliefs and values are socially constructed, privileging some view of reality and under-representing others.

Epistemology (how we come to know these multiple realities): influenced by communities of practice who define what counts as acceptable ways of knowing, and affecting the relationships between the researcher and the communities who are being researched, such that partnerships are formed that are based on equality of power and esteem.

Methodology (how we research complex, multiple realities): influenced by communities of practice who define what counts as acceptable ways of researching, and in which mixed methods have a significant role to play, as they enable a qualitative dialogue to be established between the participants in the research.

Axiology (principles and meanings in conducting research and the ethics that govern these): beneficence, respect, and the promotion of social justice.

It is argued that a transformative paradigm penetrates every phase of the research process, because it concerns the interrogation of power (Cohen et al., 2011). Mertens (2007) argued that mixed methods should be used in a transformative paradigm, as they increase the inclusion of the less-powerful voices in society and reduce the bias towards the powerful. Mertens stated that: “Participatory action research is a necessary, if not sufficient, element of transformative paradigm, as it involves people as equals” (Cohen et al., 2011, p. 33). “Participatory research, an instance of critical theory in research, breaks with conventional ways of constructing research, as it concerns doing research with people and communities rather than doing research *to* or *for* people and communities. It is premised on the view that research can be conducted by everyday people rather than [an] elite group of researchers; that ordinary people are entirely capable of reflective and crucial analysis of their situation” (Cohen et al., 2011, p. 37).

Participatory rural appraisal (PRA) and the more inclusive participatory learning and action (PLA) are families of participatory methodologies that have evolved as behaviors and attitudes, methods, and practices of sharing (Chambers, 2007). Both PRA and PLA constitute an umbrella of principles, methods, and techniques, and this mixed-methods approach makes an excellent match with the “basic beliefs” of the transformative paradigm. There are three main components of PRA: facilitators’ behaviors, attitudes, and mindsets linked with precepts for actions; methods that combine visuals, tangibles, and groups; and sharing without boundaries (Chambers, 2007). Mertens argued for and elaborated on PRA/PLA methods in transformative research (Mertens, 2009). It is, however,

important to note that PLA/PRA, or similar methodical pluralisms, have existed for many decades (Chambers, 1994, 2007; Mascarenhas, 1992; Narayanasamy, 2009). So, the transformative paradigm, and thereby transformative research, is a very recent development compared to the origin and development of the mixed-methods approach of PLA/PRA. Therefore, as the literature shows that this trend of mixed methods in the field of educational technology within a transformative paradigm is at an early stage, this empirical study is an attempt to contribute to the knowledge development. There are several reasons for this claim. First, there is a lack of in-situ action research. Second, there is hardly any evidence of long-term field-based research, except that by classical cultural ethnographers. Third, there is very little educational technology research within the transformative paradigm. Fourth, there is a lack of research that focuses on educational technology or ICT in development research using participatory action research positioned within the transformative paradigm. Fifth, to my knowledge, educational technology research has not been conducted using the principles, techniques, and methods of PRA/PLA. Last, this research demonstrates the integration of the mixed-methods approach of PRA/PLA, participatory action research methodology, and the transformative paradigm—as propounded by Mertens.

It is worthwhile to determine if there is any difference between an approach that combines the transformative paradigm and PRA (as discussed above), and a “standard” PRA approach. In this regard, the PRA pioneer Robert Chambers (2007) argued: “Theory and reflexive practice have led relatively more in participatory action research practice and experiential learning has led relatively more in the RRA-PRA-PLA sequence. At times, as in the 1989–91 explosion of PRA, not all the implicit theory was immediately made explicit. But critical reflection followed practice and principles were induced and articulated on the basis of experience” (p. 18). Mertens’ works critically reflected on PRA-PLA and explicitly discussed the relationships between critical theory, the transformative paradigm, participatory action research, and the PRA-PLA methods. For instance, in Chamber’s (2007) work on PRA-PLA, the word “transform” occurred seven times, and the phrase “critical reflection” occurred three times. On the contrary, in Mertens’ (2009) text on the transformative paradigm, the word “transform” occurred nine times, and the phrase “critical reflection” occurred four times. So, it appears that both the text on PRA-PLA and the one on the combination of PLA and the transformative paradigm put similar emphasis on the words “transform” and “critical reflection”. However, in Merten’s text, the word “transformative” occurred 100 times, making the paradigm very explicit. Therefore, in the PRA-PLA, there is emphasis on the term “transform” and the latter made the “transformative” paradigm more explicit in relation to the application of PRA-PLA. In addition, in the transformative paradigm and the “standard” PRA-PLA literature, the application of the methods and their underlying belief are the same.

1.5.2. Methodology and Methods

The methodologies of action research (Reason & Bradbury, 2008), participatory action research (Capriello, 2012) and ethnographic action research (Tacchi, Slater, & Hearn, 2003; Tacchi, Foth, & Hearn, 2007) and the application of mixed methods (Chambers, 1994; Mukherjee, 2010; Narayanasamy, 2009) within these methodologies include the aforementioned properties of a transformative paradigm (cf. paper VI and VIII). About 47% of the target groups of the ICT for development (ICT4D) studies are the “rural poor,” and 60% of all ICT4D work is done in Asia and 30% in Africa, but action research is applied sparingly (Chepken, Mugwanya, Blake, & Marsden, 2012). Therefore, this research study was

based on the principles of action research, which builds on the participatory development of inquiries. In addition, my live-in field-based action research involved the role of an ethnographer. Hence, in this dissertation, I build the research questions with the participants' views, and I take my personal experiences into consideration (cf. paper **III**, **V**, **VII**).

Paper I shows that this research began with a consideration of different theories that are related to the integration and adoption of technology in learning environments. This refers to the fact that, as a transformative researcher, I did not restrict myself to one theory or pattern. However, I carried my understanding of related theories, methodologies, and intervention strategies in the field, and the application of these evolved with participatory inquiries of the action research. Relying on mixed methods, participatory approaches, multiple methodical perspectives, and multiple participant groups allowed greater understanding and enabled a reliable validation process (as discussed in papers **III-VIII**).

The research agenda and the researcher's role were politically determined and motivated by the participation and power of the researcher and the different stakeholders (as discussed in paper **VI**). The schools' management committee gave me a consulting role that was equivalent to that of the head of the institution and with relatively higher autonomy. My services were highly valued for the resources and knowledge opportunities I brought. For instance, based on my former experiences in TTSC I knew that there is a strong need for funding, hardware resources and training. So, I began to communicate with my personal network of influential individuals from NGOs, private and public sectors. During the early phase of this project, in 2010, I came to know a program named "Computer Literacy Program" (CLP, 2012), which called for a sponsorship to pay part of the cost for establishing one smart classroom (SCR) and one computer literacy center (CLC) at the sponsored school (CLP, 2011a, 2011b). It was an NGO-initiated three-year public-private-partnership pilot program. As part my intervention initiatives, with the contribution of external funding for the PhD project a sponsorship of USD 3000 was made for TTSC (CLP, 2010) and my project become a partner of the national private-public partnership program (discussed in papers **III** and **VI**). The project partners include: an NGO named Development Research Network (D.Net), a Volunteers Association for Bangladesh, New Jersey, USA (VAB-NJ) and the Bangladesh Computer Council (BCC) under the Ministry of Information and Communication Technology, Bangladesh. At the TTSC, the SCR was established in June 2011. For SCR, the CLP provided one laptop, one 32-inch LCD TV, 200-watt hybrid solar system, one audio cable, one VGA cable, a one-year maintenance contract and four trained teachers (CLP, 2011b). The CLC was also established in June 2011 (CLP, 2011a), equipped with four laptops, one laser printer, one EDGE modem, one flash drive and two trained teachers. The initial goal of the SCR was to bring change to teaching and learning activities in relation to English, mathematics, science and geography for 6th to 10th grade students. The goal of the CLC was to provide computer literacy to an 8-student batch per month, giving BDT 500 (corresponding to USD 6.15) per month as incentive to a teacher for the additional effort of 40 hours and a BDT 200 as incentive to a student assistant (corresponding to USD 2.46) for the same duration. The pilot project provided no further explicit information about the operations and maintenance costs and services, integration or adoption strategies.

Later, I was accepted for a visiting fellowship at the project-implementing-NGO Development Research Network (D.Net) for a period of three months, from August 10, 2011 to November 9, 2011.

This enabled me to represent the rural institutions in their efforts to be heard by the development project's resource personnel. I had the opportunity to gain the views of the development project team and the stakeholders from the school and to apply my experience in both educational technology research and the rural context. Thus, this ethnographic action research was shaped by the inquiries that emerged from the experiences of the participants and the researcher.

Field-based facilitation of ICT adoption and data collection were conducted during two field studies: from August 2011 to January 2012 and from August 20, 2012 to September 29, 2012. In addition, email conversations, Skype/mobile interviews, and text conversations over messenger systems were involved from the early phase of project planning until the time that this dissertation was written. The concepts of the methodology and methods are too limited to theorize and analyze the experiences of an ethnographer's experiences from "participation in action" (Reason & Bradbury, 2008). It fundamentally changed the individuals who were involved in close interaction for the mutual interests of educational and personal lives and livelihoods. We still communicate over email, messenger, and mobile methods for discussing problems and solutions, for sharing success and failures, and for the sheer social bonding that we created.

Long-term involvement with schools, prolong stays in a village and attempts to solve problems in every step and action makes this study an atypical action research endeavor in the field of educational technology. Negotiating with the different stakeholders of the educational institution, different stakeholder of the partnership project and communicating across the culture of rural secondary institution, urban NGO and European research network – were inseparable techniques/methods. Carefully executing actions that are scientifically established methods and further prioritizing the methods that can provide reliable data were the two challenges I experienced in such an endeavor of negotiation/communication process. Now, the third challenge is communicating the methods/techniques that are discussed across the papers (i.e. paper III – VIII).

Throughout this thesis the transformative paradigm is practiced by adopting participatory and action research methodologies, and the study extensively uses PLA methods. Table 1.5 provides an overview of the methodologies, methods and participants involved in each of the papers dealing with empirical investigation (i.e. paper III-VIII). Table 1.5 also includes an overview of paper II, which is a review paper and does not include field data.

Table 1.5 *An Overview of the Methodologies and Methods*

Paper	Theme/Investigation	Methodology	Methods	Participants/Elements
II	Review of literature: barriers in integration and adoption of ICT in education.	Hermeneutic cycle (Boell & Cecez-Kecmanovic, 2010)	Initial search/sort/select from three databases: ERIC, SciVerse (the portal for Scopus and Science Direct), and Google Scholar.	Peer-reviewed articles, 2004 and later.
III	Principles, methods and techniques: to identify barriers to integrate and adopt ICT in education	Participatory Learning and Action (PLA) /Participatory Rural Appraisal (PRA) (Chambers, 1994, 2007)	Cultural transect, problem-tree analysis, semi-structure interview and focus-group discussion. Data validation: between-method triangulation and personal triangulation (Narayanasamy, 2009)	12th graders, teachers, students, admin roles, parents and the researcher (as change agent)
IV	Applies Pierre Bourdieu's theory of practice, as a theoretical framework with which to examine the social practice of technology integration of the potential adopters.	PLA/PRA	Focus group discussion, participatory census, cultural transect, mobility map. Data validation: between-method triangulation and personal triangulation	6 th -12 th graders, teachers and staff.
V	The specific barriers to buying and utilizing ICT and ways in which these barriers can be overcome	Phenomenographic analysis methodology (Larsson & Holmström, 2007)	Interview	6 teachers and 2 12 th grader students
VI	Ethnographic Action Research Methodology: involving the power and roles of the participants as a means to circumvent barriers to the organizational change process.	Ethnographic Action Research (EAR) (Hartmann, Fischer, & Haymaker, 2009; J. A. Tacchi, Foth, & Hearn, 2009; J. Tacchi, Foth, & Hearn, 2007)	Workshops, Focus Group Discussions (FGDs), Semi-Structured Interviews (SSIs), and participant and non-participant observations. Face-to-face, mobile phone, and internet-based communications for addressing problems with services and resources.	Members of the management committee, teachers, staff, and students. D.Net project team
VII	Explores barriers in accessing/adopting online information and web-based tools of the national education board and change agent's facilitation.	PLA/PRA and innovation process in an organization (Rogers, 1995, Chapter 10).	Focus group discussion (FGD), problem tree analysis (PTA), unstructured and semi structured interview (SSI), and cultural transect. Conversations over mobile and mobile-based FGD.	The management committees, teachers and staff: key decision maker and roles players in the management activities of educational administration of TTSC.
VIII	Mobile and Internet mediated extracurricular quiz contests as a strategy to diffuse Internet literacy	PLA/PRA & EAR	Cultural Transect (text notes, voice records, images, videos, drafts of formal and informal documents, and notes on the discussions, participant/non-participant observations, face-to-face interactions and activities), FGD and SSI	Contest participants: students, teachers and family, and students' kin and alumni.

1.5.3. Ethical Considerations

Here I will present the ethical considerations with regards to this participatory and ethnographic action research. Guillemin and Gillam (2004) divided ethical consideration in two types: procedural ethics and ethics in practice. Procedural ethics usually involves seeking approval from the relevant ethics committee to undertake research involving humans. Ethics in practice includes the everyday ethical issues that arise while conducting research.

Guillemin and Gillam (2004) argued that research ethics committees cannot help in the field, where difficult and unexpected situations arise and researchers are forced to make immediate decisions about ethical concerns, or when information is revealed that suggests the research or the participant(s) are at risk. They argued that action research and community-based research are exceptions with regards to ethical considerations; this is because the research is initiated or actively sought out by the participants. This research was of significantly long duration, with a large number of participants, and the research methods involved many possibilities and very high uncertainty. Thus, it was not possible to take proactive procedural action to involve research ethics committees. This was particularly because it was unknown who would be involved, as well as when and in what capacity. Therefore, procedural ethical rules were followed in the various situations by means of individual- and organizational-level verbal consent. For instance, at the school it was repeatedly declared during assembly and group meetings that data collected through various means would be used for academic purposes. The participants' verbal consent was obtained before any short-term planned data collection methods (for example, focus group discussions and problem-tree analyses) were begun. It was not possible to collect written consent forms for the mixed-methods approach used in this ethnographic action research.

In ethnographic action research, ethical considerations are dealt with by applying "ethics in practice". During the field study, I followed the ethical guidelines suggested by Tacchi et al. (2003); these were practiced as follows: First, at the beginning of the interviews, group discussions, or other methods, I would inform the participants about the purpose of my stay, what I was trying to find out, and how I would be using the information, material, and experiences I gained. It was impossible to do this for the everyday participant observation, and even in meetings, and after the first few weeks I only explained when someone asked me about my role. Second, regarding "respecting confidence", I assured the participants that I would keep the associated data confidential and non-attributable, if they so desired. Third, I tried to ensure that I treated people correctly, with particular attention to those with whom I created stronger bonds. Fourth, I was well-prepared to find ways to explore and deal with sensitive issues in the research. Lastly, every moment I considered the phrase: "Never put people at risk or endanger their well-being" (Tacchi et al., 2003, p. 29).

1.6. Presentation of Papers

The following list of papers constitutes the second part of the dissertation.

Paper I: “ICT in Education: Secondary Technical Vocational Education and Training Institute-Centered Diffusion of Innovation in Rural Bangladesh”

This paper is the first version of the project plan. It begins with the motivation stimulated by political will through the declarations and initiatives of *Digital Bangladesh: Vision 2021*. Then, it emphasizes the barriers to ICT adoption in relation to the educational contexts of the 78% of inhabitants living in the rural areas and discusses the scope of situating a qualitative research in secondary educational and TVET institutions. The review covers literature on theories, methodologies, methods, ICT-based activities in schools, and other related terms. The brief review also emphasizes the concept of *diffusion of innovations* from different literature. It includes a plan to conduct action research during two field studies and to use PRA methods as the diffusion facilitation strategy to diffuse ICT. The paper emphasizes the barriers as part of the problem statement and states the objectives of devising strategies for the diffusion of ICT in relation to different learning activities.

The paper was presented in March 2011 at the International Technology, Education and Development Conference (INTED 2011) in Valencia, Spain, and published in the conference proceedings. INTED is an annual conference organized by the International Association of Technology, Education and Development (IATED).

Paper II: “A Theoretical Framework Mapping Barriers to Integrating and Adopting Educational Technology”

Paper II calls for an emphasis on the interdependencies of barriers in relation to the integration and adoption of educational technology within the complex education system and its external environment. Positioned within the transformative paradigm, the study applies a hermeneutic method to develop peer-reviewed articles dealing with the issue of barriers in different contexts. Based on an analysis of existing categorizations of barriers, it argues for a macro-meso-micro level approach as a theoretical framework to represent the education system and its external environment. In particular, it attempts to establish the framework (paper III) that categorizes the barriers within a national holistic system. The second analysis maps and analyzes the barriers in light of this framework. It draws attention to the dependencies across policies, procedures, and practices and identifies the lack of understanding of barriers in situated contexts within the national boundaries. The reviewed barriers in relation to the educational stakeholders, educational institutions, external environments, and change agents are mapped into the framework considering the national holistic view. Taking direction from Rogers (1995) and Gallivan (2001), the paper recommends that the holistic barriers should be understood first and then addressed by considering both individual-level and organization-level barriers.

The paper was presented at an internal seminar on eLearning of Aalborg University, followed by an international seminar of the ScandLE research network held at Copenhagen in November 2012. In a revised form, it was submitted to *Research and Practice in Technology Enhanced Learning* in 2013 and accepted for peer review.

Paper III: “Application of Participatory Learning and Action Methods in Educational Technology Research: A Rural Bangladeshi Case”

This book chapter investigates three interrelated questions to understand the barriers to educational technology adoption. First, which methodological approach and which methods will enable the stakeholders of a school to extract and present interdependent barriers in their context? Second, how are these barriers dependent on their learning contexts? Third, do the barriers in the situated case indicate any pattern for a theoretical contribution? To investigate these questions, this case study involves the stakeholders of a school in the research and awareness-building process through three of the participatory learning and action methods: cultural transect, problem-tree analysis, and focus-group discussion. The paper concludes by categorizing the barriers identified at different levels and devising a categorization framework using a macro-meso-micro approach. Roughly, the macro level is the national level, the meso level is the school or organization level, and the micro level is the individual level. The external environment of the framework refers to the system that exists beyond the direct control of the individual stakeholders and organizations of the education system of a country.

The paper was submitted, peer-reviewed, revised, accepted and published as a chapter of a book titled *Changing education through ICT in developing countries*. It is published by Aalborg University Press, Aalborg, 2013.

Paper IV: “Moving beyond Adoption Barriers through Exploration of Teachers’ and Students’ Practice of ICT in Education—A Rural Bangladeshi Case”

This paper builds on Pierre Bourdieu’s (1977) theory of practice as a theoretical framework, particularly the three thinking tools—the concepts of *practice*, *habitus*, and *field*—to understand the barriers to educational technology adoption. Using participatory learning and action methods in a situated case of Bangladesh, the paper investigates the practices of ICT and related adoption barriers in three learning environments: formal, non-formal, and informal. Bourdieu’s (as cited in Jenkins, 1992) definitions of capital are used to categorize the identified barriers, referred to as the resources at stake. It concludes that diffusion strategies should be based on a holistic understanding of the barriers and not just one of the learning environments.

The paper went through major changes in the process of addressing the comments from three reviewers of the peer-reviewed *International Journal of Education and Development Using Information and Communication Technology*. It was then submitted to *Research and Practice in Technology Enhanced Learning* in 2013 and accepted for peer review.

Paper V: “Integrated Resources and Training Facilitation—A Strategic Priority When Promoting ICT in Developing Countries”

Based on a case study involving stakeholders from a rural school in Bangladesh, the paper investigates specific barriers to buying and utilizing ICT and demonstrates ways in which the barriers can be overcome. It applies the phenomenographic analysis methodology (Larsson & Holmström, 2007) to six teachers’ and two students’ interview data regarding the decision-making experience for a computer purchase, the after-purchase experience of learning computer-related skills, the integration of

the technology, and the skills in the interviewees' learning environments. Demonstrating empirical evidence, this paper suggests that technology and training facilitation should be strategically communicated at both the individual and institutional levels. It also shows that a lack of ICT-skilled individuals in the rural community is one of the major barriers to institution- and individual-level adoption.

The paper was submitted to *Contemporary Educational Technology*. The paper was revised to address reviewers' comments, and the updated version is accepted and published in October 2013.

Paper VI: "From Change Agent to Sustainable Scaffolding"

In this study on understanding and circumventing barriers to the adoption of ICT in instructional use, the paper builds on a framework of barriers to adopt ICT in education (Khalid & Nyvang, 2013), an ethnographic action research methodology (Tacchi, Foth, & Hearn, 2009; Tacchi et al., 2003; Tacchi et al., 2007), and participatory learning and action methods (Chambers, 2007). It elaborates on the study using the iterative phases of the ethnographic action research methodology. The paper emphasizes the need to involve change agents in the power roles and to focus on the participation of stakeholders in decision-making. It shows that change agents' efforts depend on the agenda and perspectives of both the donors and receivers, including the change agent/agency. Therefore, addressing the barriers to adoption depends on the participation and power of each of the roles that come into play.

The paper was presented in June 2013 at the International Conference on Participation and Power in Participatory Research and Action Research in Copenhagen, Denmark. The paper has been accepted with change by the peer review committee and it is expected to be published as a chapter of an open-access e-book by Aalborg University Press.

Paper VII: "A Change Agent's Facilitation Process for Overcoming the Barriers of ICT Adoption for Educational Administration—A Case of a Rural Bangladesh Vocational Institution"

The paper applies Rogers' (1995, Chapter 10) five-stage process model on the innovation process in an organization as a methodology to facilitate the adoption of Web-based information and communication systems, the use of which is made compulsory by the education boards. Using PLA/PRA methods, the problem statement was identified—"the institute cannot adopt in-house ICT capacity for ICT-mediated educational administration"—and subsequently facilitated. The definition of educational/school administration departs from the open systems model (2008), which originates from systems theory (Senge, 2006). Data shows that the framework of barriers devised by Khalid and Nyvang (2013) conforms to the open systems model, which led to consideration of the interconnected components of the education system as the learning organization. The study provides a deeper understanding of the barriers, portraying the conflict between national policy and local barriers to adopt the desired practices that are fundamental to both schools and education boards in Bangladesh. It also draws attention to the factors associated with field-based change agent roles (Rogers, 1995, Chapter 9).

The paper was submitted to *The Australasian Journal of Educational Technology* in March 2013, and peer review was initiated in May 2013. The paper is accepted with change, revised and submitted.

Paper VIII: “School-Based Extracurricular Contests as a Strategy for Diffusing Internet Literacy in Rural Bangladesh”

This paper elaborates on the strategies used to understand and to circumvent the barriers to diffusing Internet literacy through school-based extracurricular contexts. First, it addresses the understanding of Internet literacy, related barriers in the adoption process, and focuses in particular on *access* and *understanding* barriers in relation to the use of the Internet for information purposes. Second, it applies activity theory (Engeström, 1999; Engeström, 2005; Leont’ev, 1978; Vygotskii & Cole, 1978) to design the extracurricular context and to identify and solve the barriers. Third, it uses an ethnographic action research methodology to describe the process of learning from organizing one context and conducting research for planning the next. Fourth, it applies Bloom’s taxonomy to demonstrate that Internet literacy includes a range of cognitive skills (Johnson, 2007), which can be designed within extracurricular activities.

The paper was submitted to *Research and Practice in Technology Enhanced Learning* in 2013 and accepted for peer review.

Paper F1-F2: Intervention strategies planned as future papers

In addition to the aforementioned themes, inquiries, and papers, two more research themes were investigated as part of this action research, data were collected, and participatory analyses were conducted. Due to time constraints associated with the feedback-based development of the articles, the two themes are left as future arenas for further enriching the findings of this project. Now, I briefly present the problems and inquiries of the two future papers (numbered **F1** and **F2**) as follows.

One of the inquiries originated from the trainers and the students involved in the computer literacy center (CLP, 2010), the non-formal training center established as part of the national public-private partnership project. An inquiry originated from the problem that the plan for 40-hour training/learning before and after school hours was unrealistic because the number of working days per month and the number of available hours for conducting training did not cover an average of 40 hours per month. The students also indicated that the lack of activity and a learning content plan were major challenges in following a class. On the contrary, the trainers mentioned that students neither took notes nor practiced when given freedom of choice. Therefore, I had the role of identifying the gaps without creating a conflict.

Another inquiry concerned the question of whether a 28-day *industrial attachment* (commonly known as an internship) can be conducted as school-based, objective-oriented, and designed activity. The inquiry originated from the central problem statement of this research study (as in paper **III**): “students are not acquiring computer and Internet-related vocational and practical skills from the institute” (Khalid & Nyvang, 2013, p. 118). In particular, the problem in relation to industrial attachment is that, due to the lack of industrial opportunity in the close vicinity, these rural students need financial

and social security to attend an urban work environment. Apart from the lack of teachers and resources, the students also did not have a strong motivation for skill development because of the lack of purposefully designed activities. Therefore, the trend has become more about assessing the presence of a student in the lab instead of an effective demonstration of or a reflection of computer and Internet skills.

2

The Application of the Theory of Diffusion of Innovations



2. The Application of the Theory of Diffusion of Innovations

One of the greatest pains to human nature is the pain of a new idea. It makes you think that after all, your favorite notions may be wrong, your firmest beliefs ill-founded. . . . Naturally, therefore, common men hate a new idea, and are disposed more or less to ill-treat the original man who brings it.

— Walter Bagehot, *Physics and Politics*

In this chapter, I begin with the rationale behind the selection of the theory of diffusion of innovations (Rogers, 1995) as the guide for studying the diffusion of ICT in educational contexts of secondary education (that is, the sixth to twelfth classes). Then, I present the definitions and descriptions of relevant terminologies in connection with my roles as a change agent, innovation adoption in schools, and innovation adoption among individual school stakeholders. In the discussion, I give particular emphasis on how a change agent's roles can be methodologically and methodically performed, and how the existing systems and strategies might be facilitated for the diffusion of ICT in the educational context.

2.1. The Rationale behind Structuring around the Theory

Transformative researchers do not usually begin with a theory (section 1.4), and paper **I** shows that I was not limited to the theory of the *diffusion of innovations*. However, the inclusion of the phrase “diffusion of innovation” in the title of paper **I** and eventually in this dissertation shows sufficient indication that I considered this theory one of the points of departure for this dissertation. I now provide a brief rationale. Since my educational and research background is in computer science, I had to go through a major transformation to become a good practitioner of the humanities. Therefore, as I reverted to the epistemic faith of a social constructivist and later found myself in the philosophical arena of a transformative paradigm, I explored the theories that deal with transformation. In particular, I conducted a literature search on applications of theories that deal with the adoption of ICT for development and any other purpose that I encountered. I found three possible alternatives: *domestication*, (Berker, Hartmann, Punie, & Ward, 2006; Chigona, Chigona, Kausa, & Kayongo, 2010), the *theory of practice* (Bourdieu, 1977; Jenkins, 1992), and the *theory of the diffusion of innovations* (Rogers, 1995). As a transformative researcher, I considered my experiences in facilitating the adoption of ICT in rural schools and about strategies and barriers in relation to the facilitation and adoption in rural regions of Bangladesh. I found more guiding principles and depth and breadth of discussion to transform myself in the process of working on this project. In addition, it was not a completely new arena for me that came with unknown problems. I was not from a background of very distant cultural beliefs and practices. The participants and I were not unfamiliar, let alone having the feelings of being strangers to each other. I had been involved with facilitating ICT adoption in the study schools since mid-2009 (cf. paper **III**), and my involvement with these schools and the surrounding community began in 2007. Therefore, it was not the beginning of this research inquiry, and the selection of the theory was based on all my former experience in connection with the fields of the case and educational technology research. It was not a

mere trial-and-error selection process and but, rather a very purpose-oriented and well-embraced theory. I considered it a guide for playing my *change agent* (Rogers, 1995, Chapter 9) role in the field, where I was determined to achieve transformation for myself and for the community. Thus, as part of this project and the dissertation, I chose the theory of diffusion of innovations as a tool to discuss change facilitation from a transformative researcher's standpoint.

2.2. The Theory of the Diffusion of Innovations

Diffusion of Innovations is a theory that tries to explain how, why, and at what rate new ideas and technology spread through cultures. In 1962 Everett M. Rogers (March 6, 1931 – October 21, 2004), a professor of rural sociology and communication studies, published his seminal piece "Diffusion of Innovations" (DoI). In this first edition, Rogers synthesized research from over 508 diffusion studies and produced a theory applied to the adoption of innovations among individuals and organizations. Rogers developed and devised his theory studying diverse DoI research traditions, for over four decades of empirical investigations and accumulation of research findings in DoI research traditions. The theory of DoI is now in its fifth edition (2003). To understand the history of diffusion research, Rogers identified ten main research traditions: anthropology, rural sociology, communication, education, marketing and management, public health and medical sociology, general sociology, general economics, early sociology, and geography.

Each research tradition consists of an academic discipline (for example, anthropology, marketing, geography) or a subdiscipline (for instance, early sociology, and rural sociology). Each tradition usually concentrated on investigating the diffusion of one main type of innovation: For example, rural sociologists specialized in farm innovations. (Rogers, 1995, p. 41)

Throughout this research project, three aspects of Rogers' theory were the central guiding principles, the elaboration of which constitutes a greater part of this chapter. First, I devised communication strategies based on the model of the innovation-decision process through which an individual passes to reach a decision to adopt or reject (Rogers, 1995, Chapter 5). In particular, I emphasized on the *needs and awareness knowledge* (Rogers, 1995, pp. 162–167; Sahin & Thompson, 2006) and identified the knowledge-attitude-practice gap ("KAP-gap") (Rogers, 1995, p. 169) when I had to facilitate the stakeholders for ICT adoption in learning environments (cf. paper VII). Second, through the concept of *change agent* (Rogers, 1995, Chapter 9), I was able to understand and define my role, understand the *affordances* (Martin & Evaldsson, 2012) that the rural society and I brought together, and devised strategies to diffuse ICT in the learning environment (paper IV-VIII). Third, the model of the five-stage innovation process in an organization was considered as part of the methodological and methodical facilitation process (Rogers, 1995, Chapter 10). Chapter 3 uses the five-stage process as the structure of the chapter and emphasizes the change agent roles at both the organizational and individual levels of diffusion (described in papers IV-VIII). Paper VII also uses the same approach as Chapter 3.

In the following discussion, I present the definitions and founding principles from the aforementioned areas of the theory of the diffusion of innovations.

Rogers (1995) defines *diffusion* as a process by which an (1) *innovation* is (2) *communicated* through certain (3) *channels* over (4) *time* among the members of a *social system*;

It is a special type of communication, in that the messages are concerned with new ideas. Communication is a process in which participants create and share information with one another in order to reach a mutual understanding. This definition implies that communication is a process of convergence (or divergence) as two or more individuals exchange information in order to move toward each other (or part) in the meaning that they give to certain events. (1995, pp. 5–6)

In this dissertation, in reference to the secondary schools of rural Bangladesh, *innovation* refers to ICT in learning environments, which goes beyond the content of the text and involves the appropriation of related skills for informal use.

The *time* dimension of the definition of diffusion is involved (1) in the innovation-decision process by which an individual passes from first knowledge of an innovation through its adoption or rejection, (2) in the innovativeness of an individual or other unit of adoption—that is, the relative earliness/lateness with which an innovation is adopted—compared with other members of a system, and (3) in an innovation's rate of adoption in a system, usually measured as the number of members of the system that adopt the innovation in a given period. In this research study, both the schools and their stakeholders (i.e. particularly the teachers, staff members, and students) could have been considered as the units of adoption for studying the adoption rate and stage. Instead, the intention was to develop strategies to diffuse. Therefore, while diffusion researchers deal with this quantitative approach (cf. Corrigan, 2012), I focused primarily on the qualitative details of understanding and solving the barriers. In this action research, the inquiries were developed together with clients, as opposed to pre-set goals of diffusing and identifying the rate of adoption. It was more important to develop a qualitative understanding of the barriers and to devise strategies. For obvious reasons, it would have been very effective if the adoption rates could have been investigated and discussed with respect to the success of the strategies (cf. papers **V-VIII** and **F1-F2**).

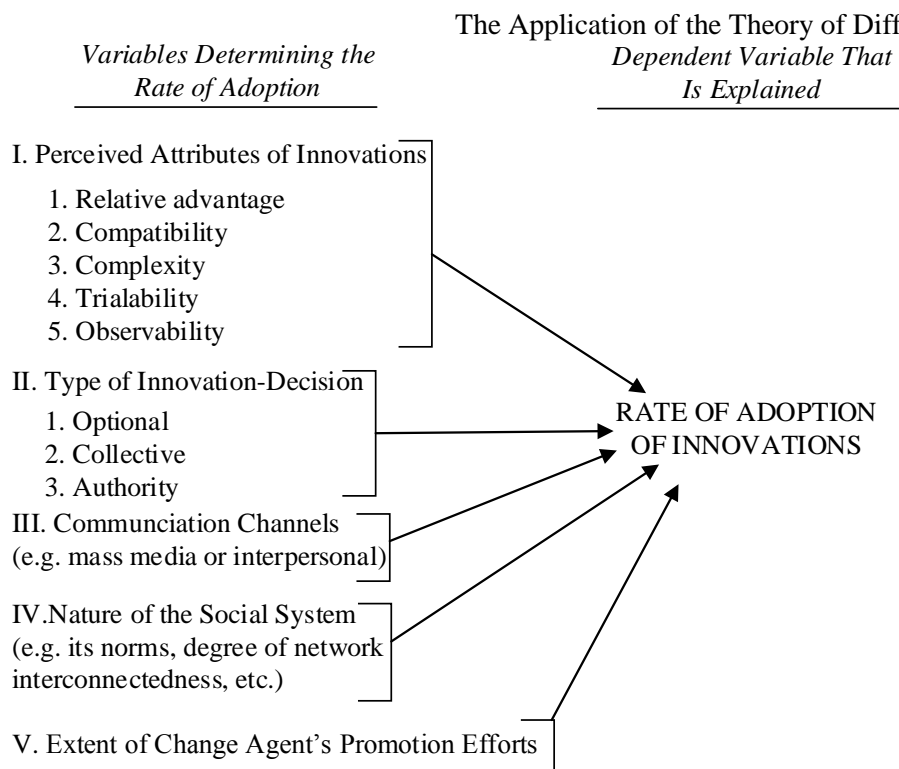


Figure 2.1. Variables determining the rate of adoption of innovations (Rogers, 1995, p. 207)

The first category of variables that determine the rate of adoption of innovations (Figure 2.1) is the perceived attributes of innovations. When considering individuals as the units of analysis, these attributes of innovations can explain their adoption rate. In particular, the five perceived attributes can explain about 49 to 87 percent of the variance in the rate of adoption of an innovation (Rogers, 1995, p. 232). In diffusion literature, both in the broad field of education and in the field of educational technology, the central object of analysis is these variables or adopter distribution and the identification of adopter categories (Corrigan, 2012; Frank, Zhao, & Borman, 2004; Rogers, 1995, p. 42; Wong & Cheung, 2009), namely innovators, early adopters, the early majority, the late majority, and laggards. However, to understand the holistic barriers to ICT adoption in a situated context and to solve barriers at the institutional and individual levels, this dissertation attempts to understand the qualitative dependencies among the existing barriers. In accepting the positive contributions of these variables, however, I find them to be misleading in educational technology research. Concerning the business trend of innovation, as Rogers emphasizes in his chapter on organizational change, much of the attention is focused on success. As Rogers also indicates, the challenges of pro-innovation biases can come through the numeric conversions of subjective behavior and leave sufficient room for criticism regarding modeling error. This dissertation, therefore, uses mixed methods on the basis of the transformative paradigm with the intention to contribute with qualitative insights from unheard voices that are overshadowed by the numerical analysis of diffusion literature.

In Figure 2.1, the second category of variables that determine the rate of the adoption of innovations is the type of innovation-decision. Innovation decisions can be *optional*, *collective*, and *authoritative*. This research was motivated by the political will and initiatives that had shown strong determination to implement compulsory ICT courses at the secondary level and the use of ICT for educational administration (as discussed in papers **II-VIII**). This means that authoritative decisions were in process, which came into effect during 2011 and 2012 (see, for instance, paper **VII**). Papers **II**, **III**, and **VII** show that a lack of computer teachers, computer support staff, computer-skilled clerical staff,

and educational technology trainers has been a major barrier to ICT adoption in rural secondary schools around the world. Beginning in 2012, information and communication technology education was made compulsory, and this further aggravated the current state of the scarcity of computer teachers (Alamgir, 2013). Another authoritative decision for upholding quality education has worsened the situation. Before the establishment of the Non-Government Teachers' Registration & Certification Authority (NTRCA), that is, until 2005, it was possible to become an instructor despite training in a different academic discipline. Such an individual was required to have some practical experience and to take some relevant certification courses. There were fewer institutes, fewer opportunities, and lower discipline-relevant degree requirements, which allowed some room to select from a pool of candidates. Presently, one must have a relevant diploma or degree and qualify in the NTRCA teachers' registration examination to become a teacher at a private TVET institute. This drastically reduced the number of prospective candidates for technical course teaching positions. The availability of teachers became heavily dependent on the NTRCA examination results, and secondary institutions have to wait for the results to be issued before deciding to publish employment notices in the newspapers. More alarmingly, the passing rate is decreasing every year: 57.64% in 2005, 22.42% in 2006, and 18.78% in 2007 (NTRCA, 2009). In 2005, there were 76,185 applicants, 58,620 attendees, and 33,788 qualifiers, of whom 10,045 were women. In 2006, 131,759 applied, 99,807 attended, and 22,381 passed; in 2007, 113,975 applied, 85,286 attended, and 16,020 passed. These relatively few qualified teachers join private institutes of three secondary educational systems: general, technical, and madrassah. During an interview, the founder of TTSC, a former director of the Directorate of Technical Education (DTE) and a consultant of DTE at the time of the interview stated that "teachers mostly fail due to failure in the general knowledge subject." Therefore, this study illustrates the barriers that rural secondary schools in Bangladesh are about to witness, similar to those of a rural vocational school that had been struggling with computer course teaching and the development of elementary computer skills. Thus, my role in the study school can be considered as that of the computer/ICT teacher and demonstrating the barriers despite an even higher-level role as an authority and enabling collective and option decision opportunities. The ethnographic action research methodology and the participants' knowledge has enriched my understanding of the barriers in situ, and I was able to explore the statistical details, as shown above, and to demand for them the right to be heard.

In Figure 2.1, the third category of the independent variables of adoption is the *communication channels*. Two individuals or units exchange messages by the means of a *communication channel*, which can be *mass media* or *interpersonal*.

Interpersonal channels are more effective in persuading an individual to accept a new idea, especially if the interpersonal channel links two or more individuals who are similar in socioeconomic status, education, or other important ways. (Rogers, 1995, p. 18)

In interpersonal communication, a fundamental principle is that the exchange of ideas occurs most frequently and effectively between individuals who are alike, or homophilous. A further refinement of this proposition includes the concept of empathy, defined as the ability of an individual to project himself into the role of another. More effective communication occurs when two individuals are homophilous unless they have high empathy. Homophily is the degree to which a pair of individuals who communicate are alike. Heterophily is the opposite to homophily. Heterophilous individuals who

have a high degree of empathy are, in a socio-psychological sense, really homophilous. The proposition regarding effective communication and homophily can also be reversed. Effective communication between two individuals leads to greater homophily in knowledge, beliefs, and overt behavior. Therefore, in following these guiding principles, I had to achieve and live with a high degree of empathy—demonstrating the role of a computer teacher and a teacher trainer at a rural school in Bangladesh. I learned that, for situated facilitation by a change agent, demonstrating empathy involves demonstrating the ability to work with the innovation, to respond to inquiries, to allow freedom for sharing untold stories, and to show trustworthiness. For instance, initiatives for organizational change often raise issues that include long-term organizational conflicts and personality clashes. At the same time, at the individual level, changing personal attitudes and beliefs often require a change agent to change according to cultural practice. In Bangladesh, where gaps among socio-economic classes are high, playing the change agent role requires the positioning of the change agent in a higher political role but also demonstrated empathy for the lowest social class. Therefore, during the field work, I positioned myself as a formal member of an NGO, as a consultant of the schools, and as a member of a family in a household that is related to the founder. These roles of the change agent yield at least three strengths. First, the role of a school consultant provides access and some level of authority to involve the stakeholders to participate. Second, the role of researchers in the NGO gives two-way access to information, decision-making individuals, and influence in conveying unheard voices. Third, the role of a member of a family, although much recognized as a guest, brings a welcome attitude to explore practices using an ethnographer's lens. In paper VI, the issues of participation and power are emphasized as part of the ethnographic action research and the PLA methods. Therefore, it was only through these formal roles in the organizations that I could become engaged in the multi-stakeholder discussion regarding the barriers. Thus, performing the change agent role of empathy by understanding the homophilous/heterophilous community is easier said and defined than done. The concept of empathy is further problematized when *norms* are brought into discussion. Norms are the established behavior patterns for the members of a *social system*. The norms of a system tell an individual what behavior is expected, such as cultural and religious norms. Norms can operate at the level of a nation, a religious community, an organization, or a local system like a village. Educational stakeholders in rural learning environments have their own norms. I developed my own intuitive understanding by attending the social festivities of the community, which includes a significant number of Hindu families, as well as the Muslim majority. From an evaluator's perspective, I would position myself as *heterophilous* in terms of my background and *homophilous* in a socio-psychological sense.

The interpersonal communications in the PLA methods enable an understanding of the barriers for the researcher and the creation of *awareness* or development of a *need* for ICT in the learning environment. At the same time, the barriers to adoption are further understood in the process of solving or circumventing them while developing mutual understanding (as in papers III-VIII).

The essence of the diffusion process is the information exchange through which one individual communicates a new idea to one or several others. At its more elementary form, the process involves (1) an innovation, (2) an individual or other unit of adoption that has knowledge of the innovation or experience with using it, (3) another individual or other unit that does not yet have experience with the innovation, and (4) a communication channel connecting the two units. (pp. 17–18)

Therefore, in this ethnographic action research, I took the opportunity to investigate existing practice and identify who had or did not have knowledge and experience in relation to ICT in education (in paper **IV**). While the two groups have conducted discussion to share experiences methodically, face-to-face communication about the innovation was facilitated. In this process, knowledge and experience about both ICT and related barriers were communicated among the participants (see papers **III-VIII**). More specifically, for instance, while organizing extracurricular contests for Internet literacy, it was the skilled students who facilitated much of the training and organizing activities and contributed significantly in the learning process. In the situated context, they were the center of knowledge and innovation that had to be facilitated with the power roles and research experience. In part, I played the role of a TTSC computer lecturer, a position that had been vacant for years, despite repeated calls for applicants.

The fourth category of independent variables is nature of the *social system* (Figure 2.1). The *systems theory* (Senge, 2006) paved the way for the development of the *open systems model* (Lunenburg & Ornstein, 2008, pp. 20–21), which defines schools as *learning organizations*. The learning organization must be studied as a whole by taking into account the inter-relationships among its components and its relationship with the external environment (Senge, 2006). A similar concept is reflected by the new paradigm of schools (Johnson, Johnson, & Smith, 2006) and the findings of the framework of barriers shown in paper **III**. Each of these models, theories, and frameworks repeatedly requires us to consider a holistic understanding of the structure of the society that evolves with and around a school. Therefore, when I attempted to identify approaches to diffuse ICT, there were formal, non-formal, and informal learning environments, which exist within the rules and regulations of schools and the norms and practices of the social system. A *social system* is defined as a set of interrelated units that are engaged in joint problem-solving to accomplish a common goal. Individuals, informal groups, organizations, and/or subsystems are the units or members of a social system (Rogers, 1995, pp. 23–31). The barriers to the adoption of ICT depend on the roles of the educational stakeholders of the open system (papers **III** and **VII**). To solve the problems associated with ICT adoption, the social system must through a transformation at both the individual and the organization level. Therefore, this dissertation elaborates on the understanding of ICT adoption barriers by indicating the necessity of joint problem-solving efforts. It involves participation and power at both the individual and the organization level (paper **VI**), which are involved in the evolving policy, procedure, and practice of educational technology (papers **V-VII**).

One of the concepts associated with the *social system of learning organization* is the process of *social change* through which alterations occur in the structure and function of a social system. When the idea of using ICT in the learning environment was communicated, adopted, or rejected, leading to certain consequences, *social changes* occurred. For instance, according to paper **VII**, when the government imposed the regulation of Web-based administrative communication, the school had to find a way to deal with it. Formerly, an office assistant had to visit the board office after the principal and teachers had prepared the documents of registration, assessment, etc. After the government's order, the principal or a senior teacher had to go to computer service shops for operators' service to access web-based systems, scanning images, and printing for records-keeping, etc. Dealing with personal information and assessment scores had always been a matter of trust. The change demanded higher trust among the employees, and in the case of involving external service personnel, the role had to be

performed by a trusted individual. However, when the service could be done by a relatively new ad-hoc employee and supported by a student, the principal and senior teachers showed trust. In addition, the teachers were eager to learn and do the task by themselves. Therefore, the traditional nature of teachers teaching and students learning began to change. This social change is strongly demonstrated particularly during extracurricular contests (in paper **VIII**). Therefore, a holistic understanding of the barriers, particularly in the situated context, has yielded noteworthy social change when organizing extracurricular contests (paper **VIII**) and institutionalizing ICT adoption for educational administration (paper **VII**).

Papers **II**, **III**, and **IV** explore the barriers to ICT adoption and the existing practices in the formal education system and the national environment, which also constitute the learning organization. So, it might be considered that the interpersonal network of the students and teachers is primarily formed by the 11 villages from which the students and teachers come. One area where Rogers' theory is applied is in the investigation of the pattern of communication networks, namely homophily and heterophily (e.g. Harrison, 2003). Paper **IV** shows that 93.5% of the students' family members have an educational attainment of the twelfth class or below, the pattern of ICT device purchases shows dependence on family members working or residing in urban areas or foreign countries, and the knowledge and use of the mobile Internet is negligibly low. These data indicate that the rural social system of the school's stakeholders is mostly *homophilic*. Although there are some elite uses of ICT and some highly educated individuals, there is little communication between the elites and non-elites. This is a barrier to diffusion. Therefore, the role of a change agent is to identify the elites and devise strategies to communicate with non-elites. Paper **VIII** shows that, during extracurricular activities, some elites conducted training and organizing. Therefore, if there are more elites and a bigger network, then, using PRA methods, it is also possible to find the nature of the interpersonal communication and network by using traditional diffusion network analysis methods.

One of the key concepts that I dealt with concerning interpersonal communication is *opinion leadership*. This leadership trait refers to "the degree to which an individual is able to influence other individuals' attitudes or overt behavior informally in a desired way with relative frequency" (Rogers, 1995, p. 27). This leadership position is not an organizational appointment; rather, it is earned and maintained by the individual's technical competence, social accessibility, and conformity to the system's norms. These leaders are at the center of interpersonal communication networks. Capitalizing on the school's administrative system, it is possible to utilize authoritative power to force individuals to become involved in activities. However, this does not create the rapport that a change agent would like to create for the PLA methods. Therefore, it is important to look for individuals who are at the center of a network and where the opinion leader has a strong *persuasive* role (Rogers, 1995, pp. 167–171). For instance, the ICT committee convener of TTSC (see paper **VII**) was selected for his opinion leadership by the students, teachers, and managers of the school. It was found that he had been a popular leader for organizing extracurricular events in schools, has family ties with the founder, and is influential in the local community. He can be categorized as a *polymorphic opinion leader* who can act as an opinion leader concerning a variety of topics. The principal of TTSC is also a polymorphic opinion leader who has a reputation among the community members for knowledge and experience. Similarly, to organize discussions and informal gatherings with different classes and concerning different issues, the students and teachers would point out the right leader among the students. In the secondary school setting, this

knowledge is capitalized for the diffusion facilitation (see, for instance, paper **VIII**). The students who are expert in computer and Internet can be categorized as *monomorphic opinion leaders* who act as an opinion leader for a single topic. Rogers (1995) made seven generalizations as follows:

Compared to followers, opinion leaders have greater mass media exposure, more cosmopolitaness, greater change agent contact, greater social participation, higher social status and more innovativeness.... Opinion leaders conform more closely to a system's norms than do their followers. When a social system's norms favor change, opinion leaders are especially innovative. (p. 332)

Regarding the topics of ICT, education, and social norms, the opinion leaders are economically solvent and have more formal education. It is, however, important to find opinion leaders with a negative attitude toward the change agent or change agency. For instance, one of the students with strong opinion leadership had to be persuaded with empowerment with certain roles and actions that reflect prestige and honor.

2.3. The Change Agent

The fifth type of independent variable that functions in the rate of adoption is the change agents' efforts (as shown in Figure 2.1). Therefore, this section is concerned with defining related terminologies and evaluating my role as a change agent, my relationships with clients, and my diffusion strategies to change clients' behavior (Rogers, 1995, Chapter 9). Part of this has been discussed in the previous section. It is important to note that I do not intend to evaluate these factors based on an analysis of the clients' assessment. Rather, the purpose is to reflect self-critically on whether I could methodically follow the theoretical outlines of DOI as my guiding principles and demonstrate a change agent's contribution in the case of a situated long-term facilitation initiative.

A change agent is an individual who influences clients' innovation-decisions in a direction deemed desirable by a change agency. (Rogers, 1995, p. 335)

The *communication* between a *change agent* and clients involves a two-way information exchange. This research employs such a communication process by using PLA methods, which also address the lack of mixed-methods research in educational technology literature. Paper **III** demonstrates how a change agent can use mixed methods from the umbrella of methods discussed in PLA literature and contribute to the understanding of the barriers in relation to ICT in education. Papers **III-V** and **VII-VIII** demonstrate the use of PLA methods as a change agent's communication media. These methods assist in developing the research inquiry through participation, understanding the barriers to ICT adoption, and negotiating solution approaches. Through these methods, the clients' message involved the explanation of the barriers in relation to the adoption of ICT in learning environments. In contrast, the agent's message involved the use of persuasive information to develop awareness, a need, and, thereby, a decision to adopt. In my role of a change agent as a teacher and a consultant, one of the messages that I tried to convey was the practice of a new paradigm of cooperative teaching and learning: "learning is a personal but social process that results when individuals cooperate to construct shared understandings and knowledge" (Johnson et al., 2006, p. 11). Throughout this project, I construct shared understandings from facilitation experiences with ICT adoption barriers for the stakeholders of learning

organizations. If the educational researchers and particularly educational technologies believe in this learning paradigm, then we should start by demonstrating that belief through our practice in research. In this regard, to demonstrate my effort, I used the *open systems model* and the concept of a *learning organization* (discussed earlier and in paper **VII**) to persuade the TTSC management to consider the external barriers that a rural school faces. The management took their time to decide on approving a separate accounting system for the ICT services for the institution and for creating telecenter access for the community. The management also observed that a 2009 alumnus of TTSC gained sufficient skills in the process of helping me and he can teach basic computer office applications, perform educational administration tasks, and organize extracurricular contexts. Moreover, the management went through a trial period, that is, after I had contributed the salary for about seven months of ad-hoc employment of this trained alumnus. Later, management decided to continue his service with institutional funds. This shows that informal learning can provide sufficient skills to contribute to curricular activities, though perhaps not as efficiently as expert knowledge.

Since, with the current scarcity of doctors and agriculturists, the role of change agents is performed by fewer professional agricultural facilitators and health workers around the world (Rogers, 1995), I demonstrate that, in the case of educational technology, this idea can also be adopted. Rogers defines these non-professional change agents as *aides*:

An aide is a less than fully professional change agent who intensively contacts clients to influence their innovation-decisions. Aides are usually homophilous with the average client, and thus provide one means of bridging the heterophily gap frequently found between professional change agents and their client audience. (p. 27-28)

The lack of teachers, professional trainers, and support personnel is the central human resource challenge (paper **II-VIII**). The same problem exists in the developed world and, in a more detrimental condition, in developing countries, including Bangladesh (papers **II**, **III**, and **VII**). Therefore, considering the low educational level and effectiveness of interpersonal communication, the paper contribution of aides (both students and teachers) are substantiated in the papers, particularly with respect to the four themes of diffusion approaches in papers **V-VIII**. Thus, it is now a matter of strategizing the training and deployment of aides in open learning systems and circumventing the barrier of knowledge and skills in educational technology research (Hew & Brush, 2006). This might not be the solution to the problem but a strategy to rescue the secondary institutions' struggles with their state of disappointment, which was the initial message I encountered. I take the idea and motivation from the decentralized diffusion strategy of agricultural and health services, where aides had been playing a significant role (Rogers, 1995). Recently, ICT mediated facilitation through female aides, called Infoladies, has made a significant contribution by providing access to health care information and services (Ahmed, Sarker, Rahman, & Haque, 2013). Therefore, education sector aides can significantly contribute, as demonstrated through the approaches of this dissertation (for instance, paper **VIII** on extracurricular contests). The teachers of TTSC suggested that, if unemployed graduates with undergraduate degrees in science, mathematics, and education could be given training to teach computer courses, then it is possible to impart better-quality skills than is possible today. Moreover, the teachers also argued that, if the TTSC alumni with HSC in computer topics can gain the confidence to teach the necessary technical support and clerical tasks, then such an attempt can be made in the rural areas.

Furthermore, the students believed that, if students are motivated and rewarded with praise and nominal remuneration, then it is possible to engage them in the process of peer training and in providing institutional services. However, it was also pointed out that there should be opportunities to seek further skills and information support from an expert, who must allow room to share ideas and respond promptly to inquiries. Thus, more decentralized diffusion of ICT in education is necessary.

Now, I move on to present briefly the change agent roles relating to my actions. A change agent's facilitation roles in a client system include seven roles: (1) to develop a need for change, (2) to establish an information-exchange relationship, (3) to diagnose problems, (4) to create an intent in the client to change, (5) to translate an intent into action, (6) to stabilize adoption and prevent discontinuance, and (7) to achieve a terminal relationship (Rogers, 1995, p. 337). In this dissertation, the client system includes the formal, non-formal, and informal learning environment within the schools and its 11 neighboring villages where the employees' and students' families live. Principally, through the PLA methods, face-to-face communication involved the client system of the stakeholders of the schools and approaches were strategized within the learning environments and across learning activities. Papers **V-VIII** describe how barriers were identified and facilitations were conducted; I shall now briefly present how far I was able to reach and how some barriers continue to resist.

Paper **V** indicates that purchase facilitation and training was one of the approaches to diffuse ICT. Six of the eight individuals were directly facilitated for purchase and paid installments to me through the principal, as they trusted me and my technology-evaluation ability. Two of them were persuaded and depended on foreign-resident family members for their purchases. The paper also discusses the experiences of the clients in the process of training and applying the technology and knowledge in learning activities. The change agent roles were two-fold: the purchase of technology, and adoption in learning activities. In terms of the purchase process, I achieved a *terminal relationship* (Rogers, 1995, p. 337), but it is difficult to claim that I prevented discontinuance. For instance, one teacher needed cash and sold his laptop. For technical support and maintenance, one of the clients visited the shop where I had purchased the resources for them. Some other clients collected my email contact information and the address of the shop for future information and support requirements (see paper **V**). Regarding training, it was also evident that there were more questions and more curiosity to learn—indicating intent to change. Therefore, it is not necessary for a change agent to gain a terminal relationship; for instance, the needs for training and technical support are a part of continuous change. The clients have not achieved that ability to evaluate computer and Internet technologies to make a purchase on their own, particularly when it involves a cost that is two to three times the amount of a teacher's monthly salary. In the case of mobile devices, however, it was observed after the extracurricular contests that the students and teachers had gained confidence in evaluating the product and purchasing with the help of an opinion leader. Thus, considering purchase barriers as a problem, the change agent role demonstrated a novel solution in the context of Bangladesh. A scaled-up research study can be conducted to facilitate integrated purchase of resources and situated training.

Paper **VI** emphasizes the participation and power roles of the change agent and the participants in the process of adopting multimedia for instructional use. This theme of diffusion initiatives includes one change agent and one group of change agencies. It is evident from the discussions that the change agencies struggle with their own administrative barriers apart from the situated barriers of the school.

With NGO-involved initiatives, the change agent must facilitate changes at both the individual level (i.e. teachers) and the organizational level (i.e. school). The change agent roles are played in the organizational innovation-adoption process and in the individual innovation-decision process. It can be claimed that, once a routine is developed and teachers start using a lesson plan, then the action to change is demonstrated. I came to know, after the second field study, that the textbooks were changed, the assessment systems were altered accordingly, the lesson plan had to be restructured, and multimedia content had to be reintegrated to be routinized again. This indicates that, for the instructional system in the secondary schools, where state tests and curriculum boards are involved and where teachers are limited by knowledge and skills there should be continuous access to a change agent to stabilize adoption.

Paper **VII** analyzes the organizational change process during the change agent's facilitation for the adoption of Web-based systems in educational administrative activities between public bodies and the school. The paper begins by describing how I dramatized while persuading the school's personnel to change practices. Eventually, the formation of an ICT committee, development of a separate financial system, training for prospective employees, and ad-hoc employment show how I achieved a situation to prevent discontinuance. It also demonstrates that, despite the teachers' and local management's positive intentions for change, it may take a year or more to convince all the stakeholders to approve the intent to act.

Paper **VIII** elaborates on the diffusion of functional Internet literacy for information use through extracurricular contests. The intention was to assist the schools to adopt the contests as annual events. However, existing dissatisfaction and stress among the employees in relation to very high workloads, a lack of teachers, unsatisfactory remuneration, and many other barriers were beyond a change agent's ability to solve. At the individual level, a significant number of the students who owned mobile phones have become self-reliant in using the Internet. This achievement, however, is not analyzed in paper **VII**. The paper also shows that, if financial support can be arranged and if the management motivates the teachers, then there is strong potential that the students can strongly contribute as aides, and teachers without a computer background can also perform the role of aides. Using Bloom's taxonomy, it has been established that extracurricular contests can significantly contribute to the development of cognitive skills and the achievement of Internet literacy for curricular goals.

I shall now discuss the *linker* role of a change agent in an educational system. A change agent's role as a *linker* can include many professions, including teachers, consultants, development workers, public health workers, and salespersons. The roles of a *linker* can be effective if feedback from the client system flows through the change agent to the change agency and if it suitably changes to fit the changing needs of the clients. I employed the PLA methods and the EAR methodology to fit ICT into the needs of the schools' stakeholders. I found that the role of linkers in the secondary education system depends on many types of professionals from different institutions (e.g. schools, teachers' training institutes, national curriculum and textbook boards (NCTB), and intermediate and secondary education boards of Bangladesh, etc.). Moreover, the diffusion system that governs the educational system in Bangladesh is *centralized*, which employs a more linear and one-way model of communication (as illustrated by Rogers, 1995, p. 367). The overall control over decisions is in the policies and procedures formulated by the government administrators and technical subject-matter experts in education boards,

textbook boards, and training organizations. Furthermore, there is a lack of skilled professionals in many areas of this inter-dependent system of linkers or change agents (Alamgir, 2013), and many other barriers exist in the course of adopting in the top-down approach. For instance, the review in paper **II** and the findings in paper **III** show that the lack of knowledge and training is one of the major barriers to adopting ICT in education. This barrier was also identified when we attempted ICT adoption through extracurricular activities and educational administration (papers **VII-VIII**). These papers show that, amidst the complex dependencies of barriers in the top-down system, the efforts of diffusion continue to lack an understanding of barriers. Research in such centralized and top-down diffusion systems continue to dig down into one aspect, such as teachers' barriers (Ertmer et al., 2012; Ertmer, 1999), which give mere understanding but do not offer a solution that is applicable for teachers in Bangladesh. Thus, in this dissertation, I undertake an alternative diffusion approach called a *hybrid* diffusion system, which combines elements of both *centralized* and *decentralized* diffusion systems. A decentralized system involves two-way communication. It is assumed that an effective decentralized diffusion system requires either (1) higher education and technical competence among practitioners so that all users are experts or (2) a simple level of technology in the innovations. In addition, "innovations diffused by decentralized systems are likely to fit more closely with users' needs and problems" (Rogers, 1995, p. 365). However, spontaneous diffusion through a decentralized system has some disadvantages: (1) innovations that require a high level of technical knowledge might lack quality control, (2) non-experts lack an understanding of diffusion strategies that might be utilized, and (3) diffusion does not occur if people do not feel a need, even if the national government decides to diffuse an innovation. Therefore, in the absence of sufficient local innovators and the challenge of need creation, there is a need to develop an alternative strategy. Papers **III-VIII** elaborate on the understanding of barriers at the adopters' level, which can be related as major challenges for implementing both centralized and decentralized systems. For instance, first, considering the centralized initiative of the national public-private-partnership program, the expert design, resources, and training for teachers require facilitation for both school-level change and individual-level (teacher/student) change. Second, digital Bangladesh initiatives (A2I: PMO, 2009; Alamgir, 2013) have created a need (for instance, the Web-based administrative activities in paper **VII**), which is in continuous struggle with barriers to achieving institutional practice. This is due to the lack of funds and the lack of skilled human resources. Third, the level of complexity in the integration and adoption of ICT in relation to school practices (i.e. instruction, educational administration, and extra-curricular activities) is significantly high considering the levels of barriers in the rural context (papers **II-VIII**). Therefore, the diffusion of ICT in the education sector requires an alternative diffusion system, particularly planned for the secondary education system of Bangladesh. Thus, based on the experiences in performing the roles of a *linker/change agent*, I devised a hybrid diffusion strategy (see Figure 2.2).

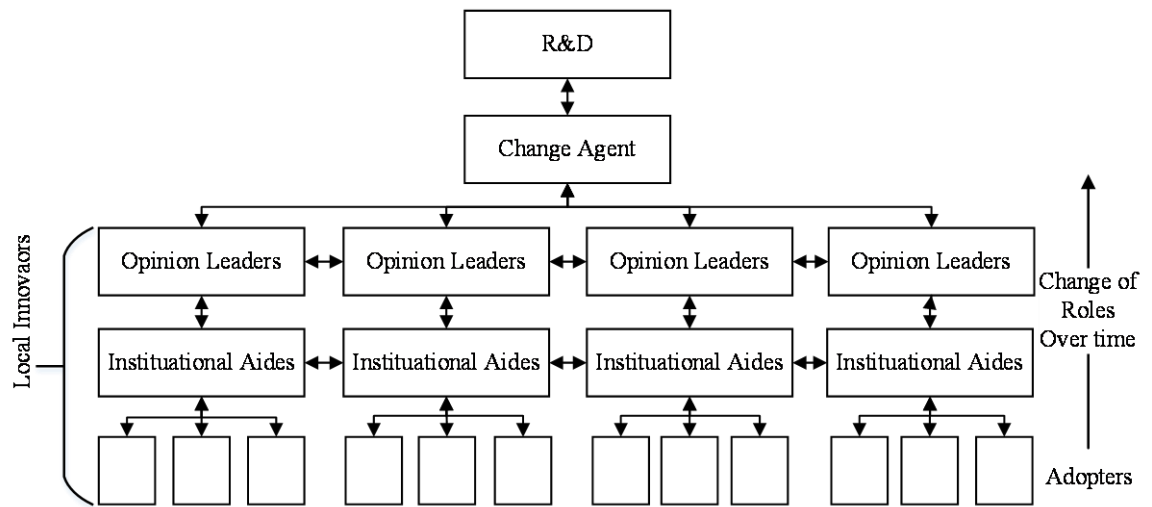


Figure 2.2 Devised hybrid diffusion system for the facilitation of ICT adoption in schools

The *hybrid diffusion system* illustrated in Figure 2.2 includes both horizontal communication and vertical communication among the *change agents*, *opinion leaders*, *institutional aides*, and *adopters* (i.e. teachers, students, staff members, management, and their families). In the course of time, an adopter can become an aide and subsequently take on the role of a change agent. Each of the local members of a community can play the role of an innovator, and the idea can be experimented with through facilitation from the change agent and diffused through communication among the opinion leaders. This hybrid diffusion system (Figure 2.2) is for schools within a local area; one can consider this as a school district or multiple school districts. The experimentation and implementation of this strategy can depend on the number of educational technologists to play the role of a change agent. The question is, again, how we can understand and facilitate the overcoming of barriers to adopting ICT in education methodically and methodologically. We begin with a research and development (R&D), which is the outcome of this dissertation. It is identified that financial support is the foremost prerequisite for any resource allocation. Therefore, educational technologists must be appointed for a specific region, and a number of schools must be allocated for facilitation. Then, PLA methods (paper III) and the EAR methodology (paper VI) can be applied with short stays at each school, starting with understanding existing practice (paper IV). Assuming that a similar pattern will be identified in rural areas, the objective would be to identify the opinion leaders, aides, and adopters. Vertical and horizontal communications are mediated by the PLA methods, where the change agent and opinion leaders facilitate the methods in periodic cycles.

In my experience, the most engaging factor was the extracurricular contests, which can be the first strategic activity. Therefore, following the approach of paper VIII, each school can be facilitated separately to organize contests for Internet literacy. Paper VIII also demonstrates the application of the EAR methodology as an iterative way to utilize the experiences of barriers for participatory facilitation for innovations. For instance, one student showed us how to determine whether a mobile device has an Internet feature just based on the external features. For facilitation, if there is a lack of adopters who can be trained to play the role of an aide, then youth voluntary organizations and students from the urban

areas can be involved as aides. During my field studies, I took help from one such aide, and formerly, I was assisted by volunteer students from a Bangladeshi university in the training sessions in the rural areas. These urban aides contributed with their personal mobile devices, laptops, and Internet connections as well. It is important to note that the cost of communication and stays must be planned by the change agent. In the course of facilitating the extracurricular contest organizing, some opinion leaders, aides, and early adopters must be identified. Separate workshops for the opinion leaders, aides, and early adopters must be organized to set the agenda for change in the course of understanding the barriers (paper III). Similarly, within-institute PLA methods will provide specific barriers to institutional change (paper III). Initially, the change agent will have to dedicate a significant amount of effort to build a rapport, to identify the key resource persons and to facilitate training according to the needs and awareness levels. In the course of time, the opinion leaders and aides will be recognized in the community, and informal knowledge-sharing practices are expected to prevail. In this process, in addition to understanding the barriers, at least two of the problems are expected to be solved in many of the schools, if not all of them. First, the schools' stakeholders are expected to gain Internet literacy for access to educational, public, and other services and information (paper VIII). Second, the schools shall have become self-reliant in performing ICT-mediated office administration, information, and communication with the education board and other regulatory and service bodies of the education system (paper VII). Depending on the level of education and skills and the aptitude to disseminate knowledge in formal classroom settings among the opinion leaders and aides, the barrier of the lack of ICT teachers can be circumvented. In the case of TTSC, the ad-hoc teacher is a HSC graduate from TTSC, and his core training came from me. Previously, due to the lack of computer teachers, the principal (with a master's degree in statistics, a B.Ed., and an M.Ed.) and the accounting lecturer used to teach some of the computer classes. Students were guided with strategies to score satisfactorily during the state tests, and records show that the students can pass with satisfactory scores. The students reflected that it is possible to score well even without hands-on experience related to curricular contents on computer. During the student life of teachers and the students' life at TTSC the learning about computer had been mostly about scoring well in the state tests by memorizing textbooks and guidebooks. Not many opportunities were there for hands-on learning. Therefore, the decentralized system can provide skills by circumventing the existing detrimental conditions—and it addresses the stakeholders' problem statement that “students are not acquiring computer and Internet related vocational and practical skills from the institute” (paper III).

2.4. Summary: Methodological and Methodical Facilitation for the Diffusion of Innovations

In addressing the central objective of this dissertation, the work contributes to the application of the diffusion of innovations theory in the education field and brings novelty through the application of different methodologies (e.g. paper VI) and methods (e.g. papers III-VIII). The theory and its application do not elaborate on how it might be applied methodologically and methodically. Of the literature dealing with the application of the theory of the diffusion of innovations, 9% deals with the field of education (Rogers, 1995, p. 43). These studies involve “teaching/learning innovations (kindergartens, modern math, programmed instruction, team teaching)” as the study of innovation, “mailed questionnaires, survey, interviews, and statistical analysis” as the methods, “school systems,

teachers, or administrators” as the main unit of analysis, and “S-shaped adopter distribution; [and] characteristics of adopter categories” as the major types of findings (Rogers, 1995, p. 43). This dissertation involves greater diversity as part of innovation in secondary education, namely, the adoption of ICT in relation to curricular instruction, extracurricular activity, and educational administration (papers **IV-VIII**). The adaptation of mixed methods (that is, PLA methods) in the education context and in the application of DOI also provides an opportunity for further research (paper **III**). The applications of mixed methods have addressed the limitations of educational technology research in relation to understanding and circumventing the barriers to adoption (papers **II-VIII**). This dissertation (papers **III-VIII**) places significant emphasis on the change agent’s roles and abilities: to influence individuals with authoritative power in the system, to mediate the unheard voices of participants, and to coordinate among change agencies. Through the use of PLA methods with the students, teachers, and their families, paper **IV** identifies the practice of ICT in 11 neighboring villages, where these participants’ families reside. Door-to-door motivational discussion and registration for the extracurricular activities (paper **VIII**) provided the scope to involve the students and teachers to play the role of *aides* or local *change agents*. Paper **III** identifies students’ challenges through the participation of both teachers and students. Paper **VII** illustrates the involvement of the management committee along with the administrative roles. Paper **VI** involves my role as a member of an NGO and the institution in playing the power role and taking the opportunity to obtain an insider role. It is argued that the idea of mixed methods in the ethnographic action research methodology (as elaborated on in papers **VI** and **VIII**) provides an opportunity to rethink the unit of analysis in diffusion research in the fields of educational technology and education. To elaborate, educational technology research literature has been placing more emphasis on the individual-level barriers, particularly when the diffusion theory or a diffusion approach is employed (Corrigan, 2012; Loogma, Kruusvall, & Ümarik, 2012). In some cases, only schools are considered the unit of analysis (Wong & Cheung, 2009). Therefore, considering either individuals or organizations as the units of analysis, diffusion scholars focus on quantitative analysis to understand barriers. Eventually, the lack of qualitative insight into the dependencies of barriers results in decision challenges in the course of solving the barriers. Thus, both organizational (i.e. rules, structure, and other factors) and individual (i.e. teachers, administrators, teachers, etc.) barriers should be considered in a diffusion study on an education system because even one barrier can fundamentally impede the adoption of ICT in education, whether it is caused by an institutional rule or an individual’s belief (Ertmer et al., 2012; Ertmer, 1999; Pelgrum, 2001). These issues can be solved by the shifting of roles: students take on the tasks of administration, teachers take the seats of students, and local members take on the role of change agents (cf. paper **VIII**). Finally, the intention of this project was not to find a pattern among the adopters but, to develop inquiries from the participants to identify ways to diffuse the innovation and explore related barriers. It was more about making qualitative a description of how transformation took place in the process of exploring and solving barriers in relation to diffusion approaches (papers **V-VIII**). It was about the experience of the process, not about finding adopter categories or finding network relationships among them (Corrigan, 2012; Loogma et al., 2012). I do not intend to misinterpret the application of DOI theory (Rogers, 1995, p. 43), nor do I intend to make a mistake by quoting Rogers out of context. Rather, in the educational technology field, I want to contribute through a different approach of methodology and mixed methods to understand and solve the adoption barriers.

3

In Situ Change Facilitation: Understanding and Circumventing the Barriers of Adopting ICT in Educational Contexts



3. In Situ Change Facilitation: Understanding and Circumventing the Barriers to Adopting ICT in Educational Contexts

And it ought to be remembered that there is nothing more difficult to take in hand, more perilous to conduct, or more uncertain in its success, than to take the lead in the introduction of a new order of things.

— Niccolò Machiavelli, *The Prince*

In this chapter, I will introduce: Rogers' (1995) five-stage process for innovation in an organization; a five-stage innovation-decision process for an individual or other decision-making unit; and the seven roles of a change agent in the process of facilitating a client who is adopting an innovation. In addition, I will discuss Rogers' categorization of innovation decisions. Then, to elaborate on the change agent experiences in the process of individual-level transformation and organization-level transformation, I will devise a combined five-stage facilitation process model by integrating the two five-stage process models and the change agent roles. Later, using the five stages, I will attempt to demonstrate a systemic, methodological, and methodical approach to understanding and circumventing barriers to the integration and adoption of ICT in the rural secondary education context of Bangladesh.

3.1. Change Agents' Facilitation Process and Clients' Innovation-Decision Process

According to the theory of diffusion of innovations (Rogers, 1995), the facilitation process for the diffusion of an innovation involves two parties: *clients* and *change agents* (as discussed in Chapter 2). A client can be an organization, individual, or other decision-making unit who makes the innovation decision. A client's decision about an innovation is not an instantaneous act; instead, there is a process that occurs over time, consisting of a series of actions and decisions. Change agents also experience a similar kind of process while strategically facilitating the diffusion of ICT in education. Rogers described the change agents' process as "the sequence of change agent roles" (Rogers, 1995, pp. 336–337). Rogers divides clients in two categories (individual, or other decision-making unit, and organization), each with a different process model in relation to innovation adoption. He developed a five-stage *innovation-decision process* for individuals and other decision-making units (Rogers, 1995, p. 163) and a five-stage *innovation process in an organization* (Rogers, 1995, p. 392). The theory of diffusion of innovations provides these three process models that can explain the facilitation process that takes place between clients and change agents. I will now briefly present these three processes in relation to the facilitation process between change agents and clients:

The *innovation-decision process* is the process through which an individual (or other decision-making unit) passes from first knowledge of an innovation, to forming an attitude toward the

innovation, to a decision to adopt or reject, to implementation of the new idea, and to confirmation of this decision. (Rogers, 1995, p. 163)

The innovation process in an organization consists of two broad activities: (1) *initiation*, defined as all of the information gathering, conceptualizing, and planning for the adoption of an innovation, leading up to the decision to adopt, and (2) *implementation*, all of the events, actions, and decisions involved in putting an innovation into use. The decision to adopt (shown as vertical dotted line in Figure 3.1, presented later in the chapter) divides initiation, composed of the agenda-setting and matching stages, from implementation, composed of the three stages of redefining/restructuring, clarifying, and routinizing. (Rogers, 1995, p. 392)

Seven roles can be identified for the change agent in the process of introducing an innovation in a client system. (1) To develop a need for change. (2) To establish an information-exchange relationship. (3) To diagnose problems. (4) To create an intent in the client to change. (5) To translate an intent into action. (6) To stabilize adoption and prevent discontinuance. (7) To achieve a terminal relationship. (Rogers, 1995, pp. 336–337).

The five stages of the model of the innovation-decision process (Rogers, 1995) are as follows: First is the *knowledge* stage, which occurs when an individual (or other decision-making unit) is exposed to an innovation's existence and gains some understanding of how it functions (Rogers, 1995, p. 162). An innovation typically contains *software information*, which includes three types of knowledge. First, *awareness-knowledge* is the discovery (typically by accident) that an innovation exists. On the contrary, some diffusion scholars argue that it is not a mere accidental or passive discovery, but rather an active behavioral change, because individuals tend to expose themselves to ideas that are in accordance with their needs, interests, and existing attitudes. "A *need* is a state of dissatisfaction or frustration that occurs when one's desires outweigh one's actualities, when 'wants' outrun 'gets'" (Rogers, 1995, p. 164). Awareness-knowledge about an innovation can lead to *needs*. Change agents create needs among clients by providing the information that an innovation exists that can serve some purpose. Second, *how-to-knowledge* involves the information necessary to use an innovation properly. Third, *principles-knowledge* consist of information regarding the functioning principles underlying how the innovation works, and this kind of knowledge may be essential to solve problems that occur. The role of a change agent is to put greater emphasis on creating awareness-knowledge and how-to knowledge (at the decision stage of the innovation-decision process). Most change agents perceive that the creation of principles-knowledge is outside their purview, and is a more appropriate task for formal schooling (Rogers, 1995). The second stage is the *persuasion* stage, when an individual (or other decision-making unit) forms a favorable or unfavorable attitude toward the innovation; the term "attitude" is defined as the relatively enduring organization of an individual's beliefs about an object that predisposes his or her actions. The third stage is the *decision* stage, when an individual (or other decision-making unit) engages in activities that lead to a choice to adopt or reject an innovation. The fourth stage is the *implementation* stage, when an individual (or other decision-making unit) puts an innovation to use. At this stage, *re-invention* occurs, which is defined as the degree to which an innovation is changed or modified by a user in the process of its adoption and implementation. The fifth stage is the *confirmation* stage, when an individual (or other decision-making unit) seeks reinforcement of the innovation-decision already made, or reverses a previous decision to adopt or reject the innovation if exposed to

conflicting messages about the innovation. So, at this stage four possibilities exist with regards to the innovation-decision: continued adoption (after prior adoption decision), later adoption (after prior rejection decision), discontinuance (after prior adoption decision), and continued rejection (after prior rejection decision).

The five stages of the innovation process in organizations (Rogers, 1995) can be summarized as follows: The *agenda-setting* stage occurs when a general organizational problem is identified and a perceived need for an innovation is defined. At this stage, both the identification and prioritization of needs and problems take place, and a search of the organization's environment to locate innovations of potential usefulness to address the organization's problems is conducted. At this stage, a *performance gap*, that is, a discrepancy between the organization's expectations and its actual performance, triggers the innovation process. In one viewpoint, agenda setting continuously occurs; in another viewpoint, the agenda-setting stage can take a significant amount of time—perhaps several years. The second stage is the *matching* stage, in which a problem from the organization's agenda is fit with an innovation, and this match is planned and designed (Rogers, 1995). This planning involves a feasibility study, which leads to the decision to either implement or reject the innovation. The *agenda-setting* and *matching* stages in the innovation process together constitute the *initiation* phase, defined as all of the information gathering, conceptualizing, and planning for the adoption of an innovation. The *implementation* phase comprises of the remaining three phases of the process: redefining/restructuring, clarifying, and routinizing. *Redefining/restructuring* occurs when the innovation is re-invented to accommodate the organization's needs and structure more closely, or when the organization's structure is modified to fit the innovation. *Clarifying* occurs when the innovation is put into more widespread use in the organization, so that the meaning of the new idea gradually becomes clearer to the organization's members. At this stage, innovations can be misunderstood, or unwanted side-effects can be experienced; eventually, the innovation becomes embedded in the organizational structure and involves social construction in the organization. *Routinization* occurs when the innovation has been incorporated into the regular activities of the organization, and the innovation loses its separate identity. The innovation process in an organization is related to three categories of independent variables: individual (leader) characteristics (i.e. attitude toward change), the internal characteristics of the organizational structure (including, centralization, complexity, formalization, interconnectedness, organizational slack, and size), and the external characteristics of the organization (e.g. system openness) (Rogers, 1995).

In an organization, there are three types of innovation-decisions (Rogers, 1995, p. 372), which are:

Optional innovation-decisions, choices to adopt or reject an innovation that are made by an individual independent of the decisions by other members of a system.

Collective innovation-decision, choices to adopt or reject an innovation that are made by consensus among the members of a system.

Authority innovation-decisions, choices to adopt or reject an innovation that are made by a relatively few individuals in a system who possess power, status, or technical expertise.

Another type of decision is the *contingent innovation-decision*, which is the choice to adopt or reject an innovation, which can be made only after a prior innovation-decision. This decision type is similar to the decision possibilities mentioned in relation to the *confirmation* stage of the innovation-decision process, which is related to the individuals or other units.

3.2. The Innovation-Decision Process: Organizational and Non-Organizational

In this section, I will devise a five-stage facilitation process model by combining the two five-stage processes and the roles that the change agents go through in the facilitation process. The devised process model can be considered as a change agent's guide for in situ facilitation in schools.

I will start by making a generalization of Rogers' (1995) two models/processes regarding innovation and adoption. There are two categories of clients: non-organizational and organizational units. So, the innovation-decision and innovation-adoption processes reside at multiple levels. For instance, the innovation-adoption process depends on various factors at different levels of the organization's structure (i.e. education ministries, education boards, schools, and others), factors external to the organization (i.e. the social system and environment that encompasses the system), and factors at the individual level (i.e. teachers, students, staff, parents, and others). Therefore, an organization, such as the secondary education system of Bangladesh, involves both non-organizational and organizational units.

I generalize the innovation-decision process as the model for non-organizational units, which Rogers defines as facilitating individuals or other decision-making units that do not belong to an organization. Before introducing the organizational innovation process, it is important to distinguish between a group of people who have an organizational role and a group of people who are not required to work according to an organizational role. An *organization* structure includes predetermined goals, prescribed roles, authority structure, rules and regulations, and informal patterns. Individual members of an organization work together to achieve common goals (Rogers & Agarwala-Rogers, 1976). Therefore, in the first instance one might consider "the innovation process in an organization" (Rogers, 1995, p. 392) is applicable for facilitating a school. However, a school's goals and objectives to impart learning also involve a continuous dependency on non-organizational units. In this regard, when I consider the concept of a learning organization (in Paper VII) and the new paradigm of learning (Johnson et al., 2006), it is necessary to build on the innovation-adoption process for non-organizational units (Rogers, 1995, p. 163). This allows considering the authority structure of teachers and the informal patterns of learning on ICT outside the institution. Both contribute to curricular content and require focusing on individuals as "roles in the learning organization." Papers II-VIII substantiate that the change agent roles in secondary educational institutions require careful attention at both the individual and organization levels. PLA methods offered sufficient insights in understanding the barriers from the point of view of individuals and the organizational structure.

In the educational context, there has not been significant research that deals with the innovation adoption/facilitation process in an educational institution. A leading, qualitative understanding of diffusion facilitation considering both individual and organization levels is understudied. For instance, in July 2013, I searched the Educational Resources Information Center's (ERIC) database for "(innovation

process in an organization) AND Rogers” and none of the six articles dealt with educational institutions. I then conducted a ProQuest search of 28 databases for full text and peer-reviewed articles using “((innovation process in an organization) AND Rogers) AND education AND institution.” From about 3,500 results, only two papers among the first 50 articles were about secondary education, employing quantitative methods, and lacking qualitative details for understanding individual- and organization-level barriers (Frank et al., 2004; Wong & Cheung, 2009). Therefore, this dissertation contributes through the application of both process models as part of the understanding and circumventing of the barriers to adopting ICT in the rural schools examined in this research project.

One of the novelties of this dissertation is the change agent’s facilitation of the adoption of ICT in the natural, original, or appropriate position of the secondary schools’ stakeholders’ educational contexts. Such a claim is based on a review of peer-reviewed articles published on educational technology, ICT, and diffusion of innovations. In the last week of June 2013, a search of the ProQuest database using “(theory of diffusion of innovations) AND (school OR education) AND (technology OR ICT)” returned approximately 14,000 peer-reviewed full-text journal papers. However, there was scant evidence of research in the trend of the application of the theory of diffusion of innovations in exploring and solving the barriers to adopting ICT in education. Then, a search of the ERIC database returned 63 peer-reviewed articles; 40 of these articles dealt with educational institutions, teacher education, informal learning, and various developmental factors related to education and technology. Again, not many studies of ICT adoption barriers in secondary education were found. Three of the articles were relevant. Richardson’s (2011) work deals with the Cambodian case of barriers to technology adoption. Others dealing with tensions between institutional structures, such as strategies, training, access to technology, technical support and time resources, and levels of adoption (Hardaker and Singh, 2011) and identifying that it is a greater priority to provide teachers with teaching skills (Fuller, 2000). Further searches identified that the use of a questionnaire survey with quantitative analysis remains the major trend in the application of DOI (Loogma et al., 2012; J. Richardson, 2009). Furthermore, the application of DOI to qualitatively explore and solve barriers in the process of adopting ICT in secondary educational institutions remains unattended. The innovation decision process of an educational stakeholder either complements or is detrimental to the innovation process at the organization level. To add, the change agent roles in a situated context contributes to both individual and organizational levels. Therefore, the qualitative insight into how individual stakeholders experience the barriers to adopting ICT in relation to educational contexts goes beyond the boundary of schools and becomes a partial view of holistic transformation. Thus, I draw attention to the qualitative details in the process of facilitating in situ transformation through exploring the barriers and their dependencies, solving or circumventing these barriers and identifying continued resistance. Most importantly, I integrate the studies on these barriers (i.e., Papers **II-VIII**) based on a mash-up devised from Rogers’ DOI theory on models of innovation processes and change agent roles.

Now, in light of DOI theory, let us problematize a change agent’s roles in facilitating the educational contexts of rural secondary school stakeholders. A school is a *learning organization*, which is an *open system* that interacts with individuals within schools, state agencies, and the external environment. It must be studied as a whole by taking into account the inter-relationships among these individuals or groups and the school’s interactions with the external environment (Papers **VII, II-III**). To facilitate the innovation adoption process, Rogers presents two process models: a five-stage process

for individuals and other decision-making units (Rogers, 1995, p. 163) and a five-stage process for organizations (Rogers, 1995, p. 392). In addition, the change agent roles are described as a seven-stage process (Rogers, 1995, pp. 336–337). As I attempted to merge the discussions on persuading individual teachers to introduce changes in their practice and eventual change in organizational practice and rules, it became more difficult to relate this with my change agent roles. Therefore, I have devised a mash-up combining the five-stage innovation-decision/innovation-facilitation process with change agent roles (see Figure 3.1). Thus, this is a holistic way to explain individual and organizational change and change agent roles at different stages.

In Figure 3.1, I have combined the change agent roles in the processes of individual change and organizational change. The communication channels in this figure illustrate that communication occurs among individuals/groups of individuals, the change agent, and the organization. These communication channels are facilitated by the change agent in the middle, indicating that the role is to create communication facilitation between individuals (i.e., stakeholders) and the organization. I amended only one phase in the change agent's role, "rapport building," which Chambers emphasizes is part of the PLA principles (Kar & Chambers, 2008). Papers **III-VIII** elaborate the methodological and methodical approaches to conducting this communication. These papers also show that I employed interpersonal communication as a communication channel. These methodological and methodical details, using mixed methods and in situ facilitation, constitute one of the central aspects of the research questions of this dissertation. Moreover, Papers **VI** and **VIII** demonstrate that methodologically the change agent's facilitation process is iterative and it is possible to consider the organizational change process as the basis for facilitation (see Paper **VII**). Last and most importantly, Figure 3.1 provides a guiding roadmap for the holistic facilitation of the individuals or groups (of stakeholders) and the organization. Therefore, in the subsequent discussion on understanding and solving/circumventing the barriers to adopting ICT in educational contexts, I follow a mix of the phases presented in Figure 3.1. The phases are: (0) prior conditions, (1) agenda setting, (2) matching, (3) redefining/restructuring, (4) clarifying, and (5) routinizing. In addition, I demonstrate the application of the devised process as a tool to discuss the findings in relation to understanding and circumventing the barriers of the adoption and integration of ICT in the schools' context.

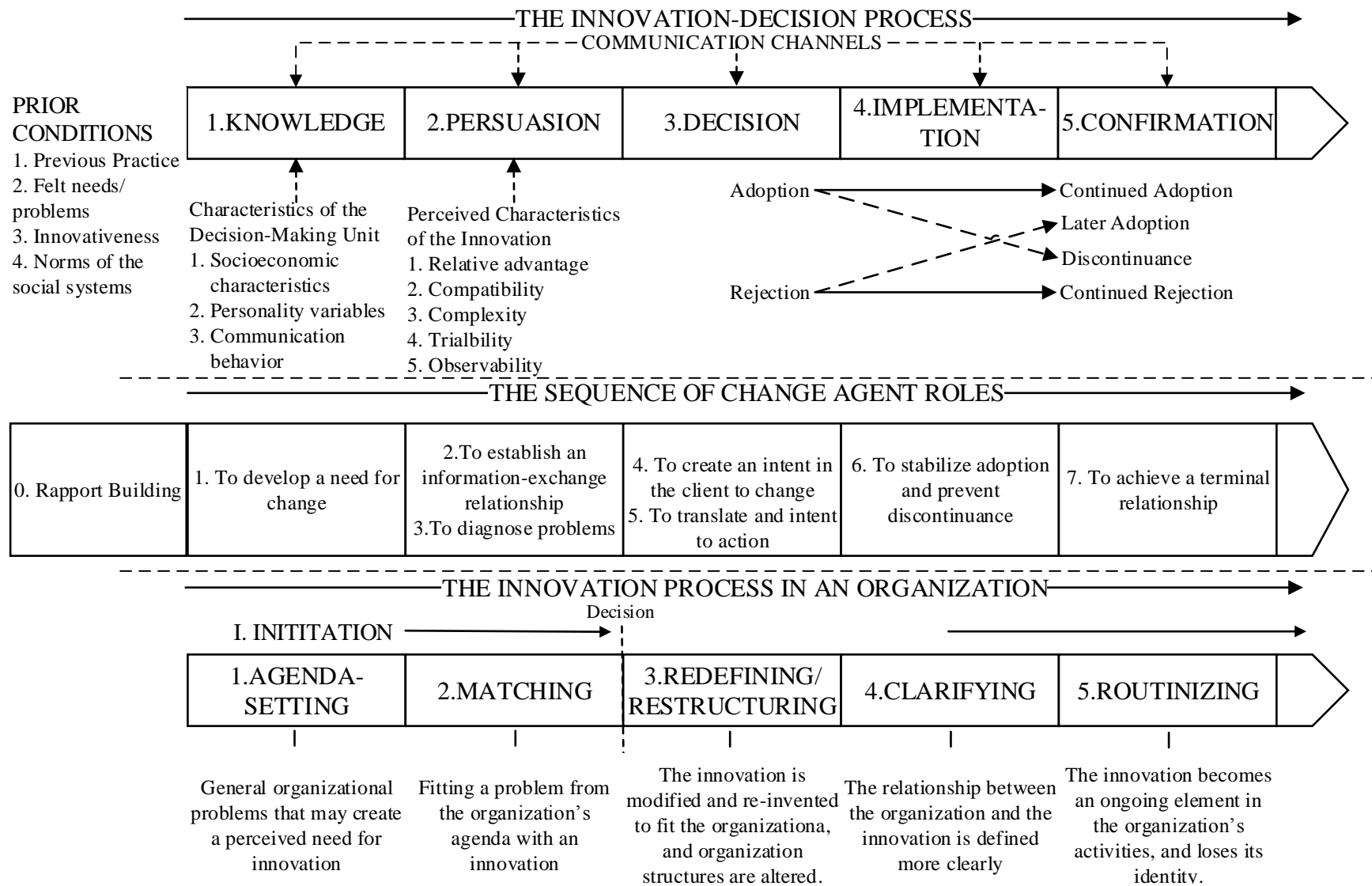


Figure 3.1. A mashup combining Rogers' five-stage innovation-decision/innovation-facilitation process with change agent roles (Rogers, 1995, p. 163,337,392)

3.2.1. Prior Conditions

When I reached the village, I began by socializing with the people to build rapport. I managed to become involved with a couple of groups of students through formal classes, informal discussions, playing games together, sharing interests about ICT resources, and inviting each other to share meals and snacks. With teachers and staff, the rapport had to be built by enabling the kinds of discussions that were expected from a new colleague. I devoted my time to taking computer classes, and fixing the computers in the labs and anywhere else in the institution where I could be useful. Meanwhile, I started a village mapping exercise with students, discussions with teacher and students, visiting nearby markets, exploring computer and mobile services shops, and understanding the knowledge and skills of the people around me. I faced difficulty in getting an Internet connection in my mobile. Making the EDGE modem work took quite some time because of the poor Internet connectivity. A (real) mouse left my printer half-dead after it ate part of the drum before dying. An instant power supplier (IPS) had to be installed to ensure that I could print when the power was out. Finally, one student's father talked to his son's family using Skype on my mobile. Therefore, I took some time to understand the barriers in relation to the access and maintenance of ICT, even beyond the educational use. In this process, the school community came to discuss these issues and it was easier to build a rapport despite being "the new man in the village."

Educational technology literature repeatedly stresses the necessity to begin with an understanding of the prior status of learners and potential technology adopters (Belland, 2009; Bruner, 1996). The questions are, then, what should we know, into how much detail, and using what methods? Paper **IV** deals with these questions in relation to the formal, non-formal, and informal learning environments. The paper identifies the barriers to technology, access to available technology, and knowledge and skills. I selected these categories based on my former experiences with the institutes, experiences in living rural life, and the literature review (i.e., part of Paper **II**). Using Bourdieu's theory of practice, this paper has demonstrated how a change agent can facilitate PLA methods to explore resources in the field. These resources are: access to ICT, access to electricity, ICT ownership, use of ICT for educational purposes, education as the profession of family members, and purchase of ICT resources. The PLA methods not only contributed to gaining understanding of barriers, but also partly initiated the first stage of diffusion process (see Figure 3.1).

When the social disposition of a resource is at stake, the nature of a barrier can then be easily understood and solution approaches can be devised. Lack of electricity is identified as an economic resource problem, because if a desktop is purchased then ensuring that the desktop runs during instruction hours leads to economic considerations. Therefore, I suggested the purchase of laptops (Paper **V**) and argued that instead of purchasing costly, insufficient, and heavy power backup system, spending that extra amount would provide more convenience. The prospective owners had the opportunity to observe and try the device during the workshops and while organizing the extracurricular contest (Paper **VIII**).

At both the individual and organizational levels, the history of the purchase of ICT resources showed a pattern: (1) lack of knowledge about ICT product quality and features is defined as cultural capital, (2) lack of markets and ICT product options in rural and semi-urban areas are defined as economic

capital, (3) distrust in rural and semi-urban areas is defined as social capital, and (4) high credibility of foreign products is defined as symbolic capital. Therefore, to develop cultural capital, I offered free training for anyone who purchased a computer and Internet resources through me and the school. To gain trust, I utilized my credibility as an expert. To address the stake with economic capital, I offered my voluntary service to communicate with major vendors and travel with resources.

Lack of formal education, English competency, and knowledge about educational use of ICT are the social capitals that are directly associated with the decision to purchase. Paper **IV** concludes that although there are financially capable families and the students had a strong desire for ICT adoption, these prevailing barriers caused resistance to adoption.

The overall practice of access to and knowledge about ICT faces the barriers of low skills (i.e., cultural capital), high cost (i.e., economic capital), and low access to support services (also economic capital). Therefore, I took every opportunity to provide skills through training on know-how and support services, in addition to financial facilities. For example, to facilitate purchases (paper **V**) I purchased the devices from vendors and received installments through the school's administration (i.e., principal) to offer participants financial convenience.

In addition to Paper **IV**, each of the strategies (including Papers **V-VIII**) to diffuse ICT includes a study on perceived needs and/or problems. I shall discuss those as part of the first phase of the innovation process in the school.

3.2.2. Agenda-Setting

Agenda-setting is an identification of the problem in an organization that may create a perceived need for innovation. It is continuously happening in every organization. At this stage, "one or more individuals in an organization identify an important problem and then seek an innovation as one means of coping with the problem." For ICT diffusion, using the hybrid diffusion system and the context of Bangladesh, it is important to consider that a problem has to be defined at multiple layers of participants, who are the central part of the PLA methods. More importantly, the action research component of EAR methodology suggests that inquiry has to be built based on client problems (elaborated on in Papers **VI** and **VIII**). Therefore, the first step was to establish my role as a change agent or linker who is the solution for a problem. Thus, I went through agenda-setting at the levels of opinion leaders, aides, and (potential) adopters (see also the hybrid diffusion system). First, my approach to the management of schools in this research was an informal communication and the agenda was: TTSC lacks computer teacher, teacher and student lack ICT skills, and there is a need for training to gain the skills of technical support and maintenance as well as ICT resources. Therefore, I was given the role of a consultant cum trainer. Second, the principal and the teachers were given the same message by the founder. I identified some of the teachers as opinion leaders and facilitated PLA methods in their presence. Third, some of the opinion leaders (both teachers and students) became my aides and accepted the premise that their knowledge and skills were the solution to the existing problem with ICT skill levels. Last, the potential adopters and the aides defined that the change agent allows more

freedom to access and to explore, and grows confidence and not fear; he can fix problems if unknown situations arise when participants try out different things on the computer.

The agenda-setting level with the students defined the problem: “students are not acquiring computer and Internet-related vocational and practical skills from the institute” (Paper III). The methodical investigation involved four stages: (1) commonly-agreed problem selection and definition, (2) cause-and-effect relationships with the problem, (3) context-dependent clarifications of causes and effects, and (4) understanding causes, i.e., why do these barriers exist? Who causes barriers and in which way? Do relationships and/or patterns appear evident? The participatory analysis and an ongoing review of the literature resulted in identifying a pattern, and a framework was developed. The framework represents the barriers in relation to the adoption and integration of educational technology (see Figure 3.2, as in Paper III).

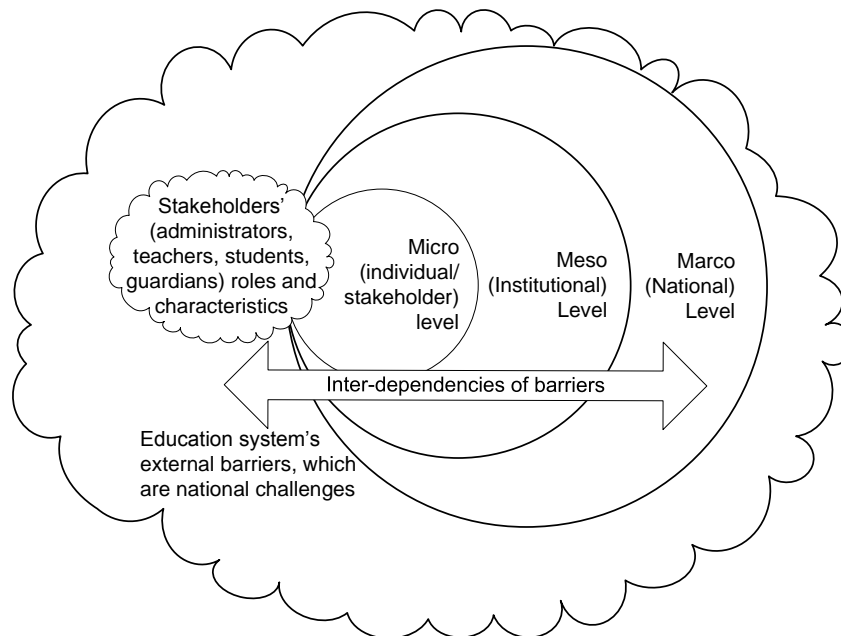


Figure 3.2. Framework of barriers in educational technology integration and adoption.

Paper III also establishes that the cause and effect relationships across these levels are dependent on the power relationships in the education system and its external environment. The adoption process requires change processes at both organizational and individual levels. Thus, through methodical exercises the understanding about the barriers became explicit among the participants and the change agent.

Paper II uses the framework as an analytical tool to review and to elaborate on the understanding of barriers. This review summarizes the barriers on multiple levels (i.e., macro, meso, micro, and external), depending on the power relationships to solve the related barriers. Literature review is a key exercise for the change agent to develop an information-exchange relationship and explore ideas for the appropriation. For instance, Paper II categorizes “teacher training” as a macro-level barrier, but a careful consideration shows that it is an all-tier problem. For instance, TTSC teachers received training from the national partnership

project, and when these four teachers returned to the school there was no resources for them to practice, let alone experiment in instructional settings (Wachira & Keengwe, 2010). Moreover, the training project did not include the settings of the multimedia classroom in which TTSC teachers were expected to teach (An & Reigeluth, 2011). Therefore, the agenda was to redesign the smart classroom and arrange workshops for teachers to provide hands-on training. This agenda was developed as I was taken to visit the “smart classroom” (Paper VI). The problems and needs were seen as threefold: (1) lack of teachers, particularly technical subject teachers, (2) lack of expertise despite coming from a polytechnic institution, and (3) lack of trainers and training.

In Paper V, the agenda for facilitating purchasing began with the lack of computers in both informal and formal settings. A formal setting is financially constrained for purchasing more computer resources, considering that the prevailing need can be facilitated at an individual level. It was particularly assumed that purchase facilitation and training would bring confidence and freedom to practice, and that gradually teachers from non-computer trades would develop the scope to contribute to the institute.

Paper VI on ICT for instructional purposes begins the agenda with the barriers, as follows. There is a lack of: TTSC funding, computer ownership for instructional activities, access to computers for classroom activities other than labs, classroom infrastructure, knowledge and skills in relation to technology, and pedagogy and administration. There is also the national crisis in terms of electricity. To address these barriers I had approached the founder, the chairman, and the principal to get them involved in the national partnership project and to consider consulting on facilitation. Therefore, the agenda was very much formally planned and the idea of a multimedia classroom was set as the agenda. Moreover, because the teachers and staff had already received training from the partnering NGO, the agenda for change was pre-set at the organizational level. However, why and how these technologies could contribute through instructional use remained questions for both teachers and students. Furthermore, at this stage I had to focus on the teachers’ adoption (as individuals) and also possible organizational change requirements in relation to the instructional process and use of only smart classrooms.

Paper VII draws attention to the event where the principal of TTSC and I came into the discussion about the need for external support for web-based systems for administrative activities and communications related to state examinations, results, curricula, etc. The discussion shows that the education boards required that all schools use web-based systems for administrative communication and information exchange. However, the TTSC and other schools in the region had to depend on external services for scanning, image editing, Internet-based communication, and printing. The institution did not have the required hardware or skilled staff, the government policy offered no attractive remuneration or provisions for computer operators or financial solvency for full-time employment. Therefore, teachers and staff needed to put in time and effort and the institution had to incur additional expenses. For TTSC, this expense is higher than the general curriculum, where state tests are held only for class 10 and 12. In contrast, TTSC has to test four times a year in classes 9–12. Therefore, I found a KAP-gap between the government’s decision and the schools’ barriers. The national level of educational organization has applied the knowledge (K) that web-based systems have potential benefits. Both the national (macro-) level and school (meso-) level have a positive

attitude (A) toward adoption and availing themselves of the benefits. However, neither of the two levels have taken sufficient measures to practice (A). Thus, the agenda was to circumvent the government's policy limitation and adopt an alternative solution to address the ICT services for the entire institution.

Paper **VIII** shows that the students pointed to the problem of the lack of Internet literacy, and they incidentally perceived the need to adopt extracurricular contests as a diffusion strategy. The paper also shows that, in terms of organizational change, the problem was the lack of computer and Internet skills among students (as in the agenda in Paper **II**). Therefore, extracurricular contests can be a strategic approach for the diffusion of these skills.

3.2.3. Matching

Matching is defined as the stage in the organizational innovation process at which the members determine the feasibility of the innovation to solve the organizational problem. In addition, this can be considered as symbolic planning to identify anticipated problems. Table 3.1 shows a summary of the problems and anticipated barriers in relation to the different strategies adopted as the solution.

The change agent role was meant to establish a strong level of trust for information exchange. I conducted workshops, training, and PLA methods as exercises in the free class slots and in the teachers' common room, persuaded teachers individually, visited houses and discussed with families and students, and attended social gatherings. For a diagnosis of problems, the problem tree method was the most effective in illustrating the causes and effects associated with the defined barriers (c.f. Papers **III** and **VII**). In the course of these actions I created opportunities and activities to provide *observability* and *trialability*. During the interpersonal communications we discussed the *relative advantages*, *compatibility*, and *complexities* of the technologies and their applications. For instance, students and teachers attended trainings and workshops for reading newspapers online, with the advantage that one did not have to buy them or wait for them to arrive. Later, one teacher told me that he enjoyed reading fresh news just before he went to bed after midnight. He also added that this was cheaper than subscribing to SMS-news. The subject teachers of mathematics and English had been persuaded individually and given individual-level facilitation to consider the possibilities and advantages of preparing for teaching in Smart Class Room (SCR). The principal and other senior teachers were provided with information about various possible barriers that had to be dealt with. From this stage the opinion leaders and aides started to appear. For instance, for regulatory issues one would point to the principal, for annual routine and examination planning another lecturer would be asked for discussion, and for technical problems one would rush to find a student who was absent from the discussion. It is important to reflect that this stage included a significant amount of confusion. Many ideas arrived in the form of possible barriers and, in the end, a good number of opinion leaders and a few aides were identified.

Another change agent role was diagnosing problems. In the course of diagnosing barriers, I came to know *opinion leaders* who were expert in solving problems. Among the students, some of the early adopters and opinion leaders became my *aides*. (To clarify, none of the students or teachers I refer to as aides were paid for their work.) Similar was the role of opinion leader. An aide is a problem-solving expert who

explicitly stated an interest to help me. An opinion leader has popularity as a skilled individual and a helping person. For instance, I was told that one student in class 10 was an expert on Internet searching and computers. Then some other students confirmed the claim. Then, this student from the tenth grade becomes an opinion leader in my list. Later, I asked the student to come to my workshop; he agreed that he would help me, and he would also receive the training that I suggested for him. At this point he became an *aide*. Similarly, an adopter can also become an aide. An adopter can also become an opinion leader without being an aide. Another lesson is that if the change agent appreciates the *aides*, then this allows other *adopters* to break their silence and opt to become an aide.

Table 3.1 *Understanding Barriers at the Initiation Stage of the Four Diffusion Strategies*

Paper	Agenda/Problem	Solution/ Diffusion Strategy	Feasibility/Anticipated barriers
V	Lack of access and lack of computer and Internet skills	Integrated resources and training facilitation	Financial insolvency, technology evaluation ability, distrust of vendors, etc.
VI	Lack of teachers, irregular student attendance, no subject-specific lesson plan, absence of continuous assessment plan by subject, teachers' fear of computer use	Curricular activity: Smart classroom (SCR)	Teachers' lack of knowledge and skills in pedagogy, assessment planning, and regulation and technical skills; lack of access to computers and the Internet; scheduling one SCR for multiple classes and multiple subjects; intra-class movement time; operations and maintenance of SCR; security from theft; lack of time for training and practice; operations and maintenance fund, etc.
VII	Performance gap caused by outsourcing ICT-dependent services	Educational administration	Lack of ICT-skilled applicants interested in rural jobs, government doesn't have provision for ICT operators or support staff, lack of skills, lack of funds for ad-hoc employment, continuous financial uncertainty, external service vouchers can be reliable but internal expense level has to be accountable, lack of technical support, lack of funds for additional resources, etc.
VIII	Students lack computer and Internet-related vocational and practical skills	Extracurricular contests: Internet literacy	Lack of funds, hardware resources, computer teachers for training and supervision; lack of teacher and student interest, organizing responsibility, etc.

3.2.4. Redesigning/Restructuring

Based on my experience from the case of this research, it is difficult to clearly separate this phase from the four previous strategic approaches to choose two. At both the individual level and the organizational level this is the longest stage in the innovation-decision/innovation-facilitation process. It includes modification of the innovation and altering organization structure.

The change agent roles of creating intent to change and translating intent to action were dependent on the agenda and diffusion strategy (see Figure 3.1). The situated details of these roles can be related to the qualitative details in Papers **V-VIII**, and examples from each strategy are summarized in Table 3.2.

Table 3.2 *Understanding Barriers at the Redesigning/Restructuring Stages of the Four Diffusion Strategies*

Paper	Diffusion Strategy	Creating Intent to Change and Translating Intent into Action
V	Integrated resources and training facilitation	<ul style="list-style-type: none"> • Bayezid in class 12 had visited the computer market in Dhaka but could not decide what to purchase. He and his father decided to purchase through me. His father paid the entire amount in advance instead of in installments. • Over Skype I talked with Asif's Europe-resident siblings in the presence of his father and demonstrated and explained why he might have a laptop and Internet access as a special gift. His family bought him the gift about one month later. • The teachers and students who purchased computers have started using these resources for information and educational administration.
VI	Curricular activity: Smart classroom (SCR)	<ul style="list-style-type: none"> • As part of the workshops, I persuaded the principal to make an annual lesson and assessment plan for his main subject and demonstrate how it might be prepared. Later, the English and management teachers followed this pattern and became guides for others.
VII	Educational administration	<ul style="list-style-type: none"> • One of my dedicated trainees was a TTSC alumnus. The principal and I persuaded him to learn to become an ad-hoc teacher and resume paid service after my first field study. I contributed about one year's salary starting from the end of my first field study. TTSC have continued his ad-hoc employment.
VIII	Extracurricular contests: Internet literacy	<ul style="list-style-type: none"> • During the last extracurricular contest, I participated with funding and the questionnaire. I observed that the teachers and students had coordinated a successful event and continued the previous year's trend of reward and penalty scores to motivate participation in the contest.

I elaborate a little further on creating intent and translating intent into action in relation to the understanding of barriers. For instance, in relation to access to resources and related training (Paper V), I identified the fact that the institution does not have sufficient funds to purchase computer resources and teachers do not have time to explore computer training during their busy schedules. The same applies to students. Moreover, when students are in the computer lab and there is load-shedding, then it becomes demotivating. Furthermore, if there is a power outage, the next availability is unknown and unpredictable. A student informed me that he went to visit the computer markets and shops in the capital city of Dhaka and found the experience too confusing, and it was difficult to trust the vendors. The same impression prevails among every individual I spoke with and, in fact, it includes me, too. I would purchase from a market only if I could evaluate the computer or if I knew the seller. Therefore, while the rural community's network had been dependent on reliable external sources (see also Paper IV), I took the opportunity to experiment with the level of trust. I offered integrated training and purchase facilitation. I discovered that a laptop costs three times a teacher's salary per month. Therefore, I decided to offer installment payments. I planned to buy laptops with cash, and the teachers and students would pay me back through the principal. This was announced in the assembly, through my opinion leaders and aides, to each class and every student. Six teachers and two students were directly or indirectly involved in the purchase decision. One of the teachers decided to buy because I assured him of training immediately after the purchase. Therefore, the underlying barriers were lack of funds and lack of knowledge and skills at both institutional and individual levels. For some, access to desired knowledge and skills was a greater barrier than funding. Although the existing literature mentions these barriers (Bingimlas, 2009; Hew & Brush, 2006; Khan et al., 2012), this research broadens this understanding through qualitative details.

3.2.5. Clarifying and Routinizing

In the event of a change agent facilitation process in the organization (i.e., school) and at the individual (i.e., stakeholders) level, it is difficult to separate these two stages. Considering the fourth stage shown in Figure 3.1, it is difficult to claim that at both the organizational and individual levels it was possible “to stabilize adoption and prevent discontinuance.” In addition, at these two stages, it would be inappropriate to generalize the understanding of and the solution approaches to ICT adoption barriers. These stages are defined as follows:

Clarifying occurs as the innovation is put into more widespread use in an organization, so that the meaning of the new idea gradually becomes clearer to the organization’s members. . . . The clarifying stage in the innovation process in an organization consists of social construction. . . . Routinization occurs when the innovation has become incorporated into the regular activities of the organization, and the innovation loses its separate identity. (Rogers, 1995, p. 399)

In Table 3.3, I summarize the individual level implementation and confirmation stages, with the clarifying and routinizing stages of the organizational adoption process and with the change agent role “to achieve a terminal relationship.” First, considering the resource purchase and training facilitations, it is clear that a terminal relationship could be achieved by the time the installments were paid off and planned training was facilitated. However, discontinuance at a later period brings us back to the matching/persuasion stage in relation to the purchase process. Second, discontinuation of the SCR strategy occurred at the confirmation/routinizing stage. Third, ICT use for educational administration has become institutional routine and a continued adoption at individual levels of the administratively-responsible teachers and staff. Fourth, to understand the routinizing state of extracurricular activities as annual activities we have to wait until the end of year 2013. In sum, the authoritative decision and the process of the education board for the use of ICT has created the necessity for school adoption, and the hybrid system of diffusion may contribute. Educational administration is also contributed to by the personal laptops and individual skills (see Paper V). It is substantiated that the aides are in continuous connection with the school and they are contributing to both formal teaching and educational administrative through their computer and Internet skills. Thus, there is sufficient room for considering the hybrid diffusion system, facilitating Internet literacy, and integrated resources and training.

Table 3.3 *Understanding Barriers at the Clarifying and Routinizing Stages of the Four Diffusion Strategies*

Paper	Diffusion Strategy	Clarifying and Routinizing
V	Integrated resources and training facilitation	Installment payments were paid off on time. One teacher sold his laptop and accessories due to need because of sickness; one teacher visited the source of purchase and received free support. Internet connectivity is location-dependent.
VI	Curricular activity: Smart classroom (SCR)	The ICT committee is responsible for annual routine in terms of SCR scheduling, monitoring, addressing training needs, digital content facilitation, operations and maintenance support, related funding, etc. One teacher is primarily responsible. He has nearly double the teaching hours that he was appointed for, and other related preparation hours add up. Movement between SCR and regular classrooms reduces effective time in class; startup and closing require additional time; keys for two subject teachers and the ICT committee were planned but not done; startup and closing overhead reduces effective lesson duration. One trained English teacher left TTSC. SCR routine was in effect for one year, i.e., during 2012; new textbooks do not match digital content and annual lesson outline has to be recreated. SCR has been temporarily discontinued from 2013.
VII	Educational administration	ICT committee has yet to understand its full role in the new ability to own and operate a separate bank account to provide services as a telecenter. The ad-hoc ICT teacher cum office assistant is low-paid for double roles. BTEB policies would not allow him to apply for public-contributed posts in TTSC. Annual ICT fees per student are in operation, but do not accumulate even one month's salary for the ad-hoc employee. In the event the ad-hoc employee leaves, the principal and other teachers will be able to continue practice. Student aides (some are 2011 and 2012 alumni) continue to help with the tasks now and to help the teachers with computer and Internet use issues. The strategy has reached the routinizing state for the institution.
VIII	Extracurricular contests: Internet literacy	Orders from management, allocation of funding (internal or external), and motivation of the ICT committee are prerequisites to continue the trend in 2013. Alumni (aides) have expressed a willingness to provide voluntary support as before.

3.3. Summarizing the Understanding of the Root Causes and Strategies

I now look back to the first phase, i.e., agenda-setting with the students and teachers. We identified the causes of the problems related to the adoption of ICT and gaining quality skills (cf. Table 1 and Figure 2 of Paper **III**). I also consider my experiences in the secondary educational institution context and the evidence that I was able to put into black and white. I then attempt to summarize the root causes of the barriers that I struggled with the most and which much effort was spent in finding ways to circumvent and solve. I take Bourdieu's idea of transforming subconscious actions into explicit and conscious reflections. The barriers are the lack of funding, knowledge, and skills (see Table 3.4), and coordination between state policies and practices (Bingimlas, 2009; Hew & Brush, 2006; Khan et al., 2012; Rahman, 2012).

Table 3.4 *A Summary of Barriers to Adopting ICT in Secondary Educational Institutions in Bangladesh*

Category	Funding	Knowledge and Skill
Organizational/ Individual: Macro-, Meso-, Micro- levels	Access to computer and Internet resources, technical training, school and rural infrastructure, electricity, higher student population than available resources, insufficient number of labs, low teacher retention, lack of motivation and attention in teaching activities, lack of ICT-resource maintenance and troubleshooting, lack of employees, lower salary levels than other organizations, fear of computer use, lack of supplementary texts on ICT, lab classes are not held regularly due to lack of teachers, lack of scope for internship	Lack of teachers, technical support, and parent awareness; quality of students, teachers' technical skills and subject expertise; lack of motivation and attention in teaching activities; lack of English proficiency; local managing committee lack sapient members; exercises do not sufficiently appropriate the use of computers for practical needs; lack of library; lack of general knowledge about the nation and the world; lack of direction from teachers; teachers lack application skills despite coming from polytechnic institutes
External	Access to computer and Internet resources outside school, telecom network connectivity, communication system infrastructure, family's ability to afford purchase ICT resources, financial insolvency of family	Negative attitudes, lack of access to computer and Internet resources, distrust of computer vendors, students lack motivation, decreasing honor of teachers, low levels of formal education among families

The major causes or barriers to adoption are created by the centralized diffusion system, which lacks of coordination among its numerous policies and practices (Glewwe & Kremer, 2006). These are as follows:

- Low rate of passing in teacher registration exams by subject teachers caused by the high rate of failure in the general knowledge test
- Qualities of students degrade due to emphasis on state test score as the emphasis for learning
- Quality ICT-skilled graduates are expected to become teachers and accept relatively much lower salaries than in alternative professions (Asadullah, 2006)
- No incentive for teaching and living in a disadvantaged rural environment
- Enforcement of the policy that only subject-specific graduates with teacher registration exam qualification can teach, leading to an extreme lack of ICT graduates in the country
- Less manpower on education boards, with a high rate of increase in educational institutions and student population
- Although the majority of secondary educational institutions are private, there are more regulations for these institutions due to former evidence of corruption within these institutions. However, the successful and disadvantaged institutions receive almost no patronage

Since there has been a significant change in the practice of ICT in Bangladesh and little research has addressed this recent trend of change, I shall now present excerpts from a newspaper article (Alamgir, 2013) to allow the reader to relate it with this dissertation's findings and suggestions. In the absence of research publications on the ICT in secondary education context of Bangladesh that can be involved to validate the finding and raise awareness, the discussion around this media article is a way to iterate some of the issues of emphasis. Principally, this is to draw attention to the challenges of the centralized diffusion system and

centralized organization system in secondary education systems in Bangladesh. It is a strictly top-down system of decision-making and power exercise, which hardly allows any scope for feedback to be considered. In a centralized diffusion system (c.f Chapter 2; Rogers, 1995, p. 367) includes R&D at the top-most tier, which is followed by the subsequent tiers comprised of change agent, opinion leaders and adopters. I suggest a more decentralized approach and working with a hybrid diffusion system that addresses the barriers elaborated above and mentioned below.

- Type of Innovation-Decision: Authority

The government has introduced information and communications technology as a compulsory subject from this academic year [2013-2014] for higher secondary students taking the public exams in 2015. . . . ICT would be a 100-mark paper. The course will have six chapters — information technology: world and Bangladesh perspective, communication system and networking, number system and digital device, web design and HTML, programming, and database management system. (Alamgir, 2013)

The secondary education system of Bangladesh is a centralized diffusion system and imposes authoritative innovation-decision at the macro- (national) level through the implementation of newer policies but the meso- (school) level experiences adoption barriers. For instance, as new policies are implemented for compulsory ICT subject, there is an increasing demand of computer teachers certified by NTRCA and more knowledge and skills on computer among the teachers of other subjects (c.f. paper III). Only one teacher per subject in the school level and lack of funding to hire daily-basis or part-time teachers is a barrier that cannot be lifted out of the data from the participants. Teachers appointed for a subject different from mathematics or science can possibly prepare for teaching as s/he has studied a similar curriculum. However, for a new subject and curriculum a mere authoritative decision to change curriculum or assessment might not be as sustainable as any other. Integration of ICT in the teaching and learning practices involve far greater complexities and skills in the rural schools of Bangladesh.

The following discussions include barriers particularly to the higher secondary institutions.

- National government administrators as change agents:

[T]here were no specialized teachers for computer education in government colleges as there was no such position in the institutions. . . [A]lmost all higher secondary educational institutions had computers. . . . [G]overnment colleges had no specialized teachers for computer education. But teachers of others science subjects had training in ICT education. . . . [M]ost of the private colleges had computers and teachers for computer education. “We [the Directorate of Secondary and Higher Education] will take step to create positions of computer teachers in government college (Alamgir, 2013).

The government’s administrative officials are playing the roles of change agents at the macro level (i.e. the Ministry of Education) and patronizing the organization system at the meso level (i.e. public

colleges). Although the public schools receive more patronage and more barriers exist among private schools and colleges, the private institutions are used as examples when drawing examples and references. Optimistically, this supports this dissertation in the decision to select a private institution. However, if other science teachers with ICT training are expected to contribute to the process, then why does one appointed computer teacher have to be a computer science graduate? Moreover, the time required to create posts and eventually appoint teachers creates additional funding barriers for each institution. Furthermore, while there is a prevailing lack of teachers, recruitment of technically skilled teachers is a far greater challenge (Asadullah, 2006; paper II, p. 15-16; paper III, p. 119).

- Lack of technical subject-matter experts as change agents:

[T]eachers not having academic background in computer science and engineering would not be able to impart computer education on students. . . . [A]lthough many colleges had computers, students were hardly allowed to use them. Only a few colleges have computer labs but computers with Internet connectivity are a must for computer education. Multimedia classrooms will help students to be conversant in computer education (Alamgir, 2013).

Lack of knowledge and skill is one of the major barriers (Paper II, p. 15-16). So, in the secondary education system of Bangladesh, which is centralized and authoritative diffusion system, it is very difficult to have formally trained subject-matter experts to play the role of change agents. Therefore, a hybrid model (Chapter 2, Figure 2.2) is required, which will allow other subject teachers or staff to take the roles of *institutional aides* and facilitate adoption. Considering the lack of funding and lack of computer science graduates, the quality of education might be even more compromised if some level of scaffolding facility through *institutional aides* is not arranged.

- Opinion leaders:

The teachers [Computer Engineering teachers at an Engineering University] said that the government had hurried the introduction of the ICT as a compulsory subject for Class XI. The course has been made compulsory for Class VI in 2012 and it should be gradually expanded for students up to Class XII (Alamgir, 2013).

In the centralized system of Bangladesh, these teachers are the opinion leaders at the macro level and they get good recognition in the mass media but do not get much recognition in the diffusion decision or strategy formulation in case the opinion does not match with the political agenda. On the contrary, this study showed that the computer-expert students could play a significant role once they were empowered (see, for instance, paper VII and VIII). Therefore, by the time the conflicts among the policies are recognized by the macro level, the adopters at meso- and micro- level needs to sustain by identifying alternative strategies to cater to the needs. In this regard, this dissertation contributes with a holistic understanding of ICT adoption barriers.

4

Conclusion



4. Conclusion

For one change always leaves a dovetail into which another will fit.
— Niccolò Machiavelli, *The Prince*

This dissertation has dealt with the problem that ICT is a relatively new field in the education systems of Bangladesh and there is a need for in-depth research in relation to the barriers to integrating and adopting ICT in learning environments (Khan et al., 2012). In this respect, the dissertation has addressed the following two main research questions:

- How can we apply the theory of diffusion of innovations *methodologically* and *methodically* to *understand the barriers* to adopting ICT in the learning environments of the stakeholders of secondary education?
- How can we apply the theory of diffusion of innovations *strategically* and *systemically* to *circumvent the barriers* to adopting ICT in the learning environments of the stakeholders of secondary education?

These “how” questions are centered around five issues: methodology, methods, strategy, system, and understanding and circumventing barriers. These questions not only call for an understanding of and solutions to the barriers, but also extend to the process of gaining deeper knowledge. For example, how should a *methodology* be implemented, with which *methods*, in the iterative efforts to achieve sustainable change? Similarly, how can we circumvent the barriers rooted in the *systemic* power-based relationships and their conflicts around decision and interests? A sixth aspect that the two research questions relate to is the theoretical ground. The two research questions are answered by summarizing their contribution in relation to each of these six aspects of the research questions.

First, the existing literature on the barriers to ICT adoption in educational technology was found to have methodical limitations, and consequently a mixed methods approach was suggested (Hew and Brush, 2006). Therefore, from the transformative paradigm, school stakeholders were involved in the awareness-building and research process through the application of three participatory learning and action (PLA) methods (Chambers, 2007; Narayanasamy, 2009): cultural transect, problem-tree analysis, and focus-group discussion (Paper **III**). Similarly, the application of these mixed methods was extensively demonstrated (cf. Paper **IV-VIII**) to devise a problem statement and to understand the interdependencies among the causes, that is, the barriers.

Second, the UNESCO-recognized ethnographic action research (EAR) was applied methodologically to combine the approaches of both ethnographic and action research. Central to the ethnographic research approach has been the tradition of understanding different cultures (Bourdieu, 1977; Hammersley & Atkinson, 2010; Jenkins, 1992). This is not an ethnographic study, but in order to understand and solve the barriers to ICT adoption it deals with the cultural practices and norms of the social system. In this dissertation, the core concept of action research has been about devising

participatory inquiry and addressing participants' problem statements (Reason & Bradbury, 2008; Tacchi et al., 2009). The application of EAR methodology has been exhibited as iterative cycles of the participatory facilitation process in order to understand and circumvent the barriers to ICT adoption in curricular activities (cf. Paper **VI**) and extracurricular activities (cf. Paper **VIII**). The applications of EAR methodology involved interpersonal facilitation for the mutual contribution in understanding and solving the barriers.

Third, this project has formulated and facilitated ICT adoption through six strategic approaches : (1) curricular activities through instructional use (cf. Paper **VI**), (2) extracurricular contests for diffusing Internet literacy (cf. Paper **VIII**), (3) computer and Internet-based educational administration (cf. Paper **VII**), (4) integrated facilitation for resource purchase and training (cf. Paper **V**), (5) before- and after-school non-formal training (future Paper **F1**), and (6) reform of the practice of intuition-centered industrial attachment or internship (future Paper **F2**). In the course of formulating and facilitating each of the strategic diffusion approaches the qualitative understanding of barriers has been attributed and solution approaches have been demonstrated.

Fourth, the top-down centralized secondary education system of Bangladesh establishes policies, procedures, and practices according to political will (Alamgir, 2013; Rogers, 1995, pp. 364–369). Therefore, this project was conducted with attention to the power and participation factors (cf. Paper **VI**). In this system, there is little or no scope for participation from the schools, colleges, teacher trainers, and other roles that are not on the government's administrative and expert consultant list. Therefore, in a departure from Rogers, this dissertation has devised a hybrid diffusion model that can allow horizontal and vertical communication among the potential adopters and beyond (cf. chapter 2). This model is derived from the experiences of strategically facilitating ICT adoption (cf. Papers **V–VIII**).

Fifth, this dissertation contributes a novelty in the trend in application of the theory of diffusion of innovation (Rogers, 1995, Chapter 9) in the process of following a guiding manual for performing change agent roles (cf. Chapters 2 and 3). The chapter also elaborates how a change agent can apply PLA methods to mediate interpersonal communication and enrich mutual understanding of the barriers. The application of DOI in the fields of education and educational research had focused on identifying individuals' rate of adoption (Corrigan, 2012; Loogma et al., 2012). However, its potential as a change agent's guide to facilitate individuals and organizations (i.e., schools) has remained understudied. Therefore, based on my field experiences, this dissertation has illustrated a process that combines Rogers' five stated individual (teachers' and students) innovation decisions and organizations' (schools') innovation-facilitation process in terms of change agent roles (cf. Chapter 3).

In these five paragraphs, I have summarized the methodological, methodical, strategic, systemic, and theoretical contributions of this dissertation to the process of understanding and solving the barriers.

Now, I shall summarize the understanding and solving experiences in the relation to the barriers, by using the chronological development history of the papers. The barriers exist in complex dependency relationships, which can be categorized at different levels of the centralized education system (Paper **III**). At the micro or individual level the lack of knowledge and motivation is the most significant

barrier. At the meso or school level the lack of teachers and technology resources is the significant barrier. At the macro or national level the lack of government planning and the lack of teacher training are the significant barriers. The education system's external barriers and the external environmental barriers include lack of electricity, lack of telecom network connectivity, lack of sources from which to purchase resources, and negative attitudes of the society. Based on the framework developed in Paper **III**, a literature review showed that the same terminology labeled a barrier can be experienced differently at different levels of the education system (Paper **II**). For instance, lack of knowledge and skills can be about specific technology, technology-supported pedagogy, and/or technology-related-classroom management (Hew & Brush, 2006). The review shows that knowledge can be developed from personal experience in family and social environments, but knowledge that involves both technology and pedagogy requires more formal training. In some cases this training should consider the specific local conditions of the school that are prerequisite to adopting the technology in teaching/learning activities (Paper **II**). Paper **IV** applies Bourdieu's theory of practice to understand the barriers as four types of capital.

The barriers that are categorized as cultural capital at stake are: lack of knowledge and skills to evaluate the quality of the ICT product, low level of knowledge and skills to operate the product, low education level of family elders, and lack of proficiency in English. The barriers that are categorized as economic capital at stake are: access to electricity, transportation system, and ownership of ICT resources. The high level of trust in foreign products and low level of credibility of local ICT resources are categorized as both social and symbolic capital. From these analyses of barriers, I took the understanding that economic capital is relatively easier to facilitate in terms of resources. However, the cultural capital of knowledge and skills and the social/symbolic capital of trust and credibility of native products and thereby native vendors are relatively far-reaching barriers. Particularly, the challenge of lack of trust in the mindset of people in general is the greatest challenge of all.

Distrust and the sense of risk are higher among those who lack the ability to evaluate a product, service, or individual. Fear and distrust are higher among those of lower social or economic status. These fears, however, are not validated as such and arise from experience. These demand greater attention and facilitation for a major cultural change. Paper **V** shows that, as I took the responsibility for purchasing and offered installment facility, six individuals took the opportunity. Two more individuals were motivated by interpersonal interaction and the opportunity to receive training during my stay. The in situ training opportunity was one of the motivating factors. It also saved a significant amount of time. These occurrences were used as their own training resources. Subsequently, these resources were used for educational administrative activities, personal learning resources, and support resources for organizing extracurricular contests (cf. Paper **VIII**). Paper **VI** shows that school-level and individual-level changes were interrupted by the change in the national curriculum and in textbooks. The annual lesson plan, digital content plan, and the routine for the smart classroom were discontinued. In this regard it is a barrier created by the centralized diffusion system, which governs aloof from all other initiatives. Paper **VII** identifies that the need for funding to appoint an office assistant is a major barrier for which the national level is responsible. A separate ICT management committee with a separate bank account and autonomy to take prompt actions is one of the solution approaches that worked in this context. However, the long-term sustainability is yet to be identified. Another solution approach was

training a young, local, dedicated individual to assume the role of ICT office assistant; this had become more feasible for both the employer and the employee.

Paper **VIII** shows that to browse and search the Internet, extracurricular contexts can be effective in providing Internet skills to both teachers and students. The activities of these contests circumvent some of the prevailing barriers and appropriate the needs at the local level. Situated facilitation is required to identify the experts from the school and promote them as aides. These experts become the change agents to conduct subsequent contests. These contests are dependent on external motivation, management committee's motivation, and allocation of funds. At are various "needs and awareness" (Rogers, 1995, pp. 162–167) and both require facilitation for adoption of ICT in relation to learning activities. In addition, it is discussed in Paper **VII** that the education board's results, notices, and news are made available on the website. In TTSC, students and teachers lack facilitation and thereby there had been challenges to using Internet for these purposes. Teachers lack a strong motivation to adopt this technology for instructional purposes. Therefore, in both cases, one might conclude that lack of needs and of continuous access to facilitation are the major factors. Therefore, a top-down view would say that the client is faced with barriers of need or awareness and a bottom-up response would be that there is lack of facilitation (cf. Paper **II**). Although evident, I find it inappropriate to generalize as such.

In sum, central to the barriers are the lack of funds, high distrust and lack of skilled human resources, particularly computer graduates, subject-specific teachers, and technical support for computers, electrical, and electronics (cf. Paper **II**). These barriers are situated at the levels of individual stakeholders, organizations that are part of the education systems' rules and regulations, and the external environment, comprised of social and non-social factors. The public policies governing secondary education systems' employment, curriculum, and assessment form a central diffusion system, where the overall control of decisions and direction around diffusion is in the hands of government administrators and technical subject-matter experts (Alamgir, 2013; cf. Chapter 3). In the top-down system either the policies have to reduce the conflicting causes or a parallel hybrid diffusion system has to be brought into play. NGOs can play a major role in creating such a hybrid diffusion system as devised in this dissertation.

In conclusion, I take the quote that I put at the beginning of this chapter and consider the six strategies as signs by which to find the dovetail that might fit the next. Overall, the six strategies generated a lot of knowledge and they were successful components of the research project. When it comes to the development of school practices, however, the success was more diverse. The attempt to use a smart classroom for instructional purposes contributed pedagogical training to adopt lesson plans, continuous assessment, and rethinking of activities for learning (cf. Paper **VI**). Most importantly, successful implementation is dependent on the power to integrate the resources and adopt the activity. The change of textbook and need to revisit the planning cycle are now dependent on individual decision, unless an authority-supported agent (like me) comes into the picture. The smart classroom has been discontinued with the change of textbook, which affects every other strategic component at least by eliminating an environment that provokes questions, and provides awareness and the potential development of need.

Paper **VII** showed that the priority training of a local alumnus, institutionalizing an ICT committee, and allowing a separate bank account for the ICT committee had started to move toward sustainable adoption about a year and a half following the time of change initiation. The hardware resources for non-formal training and industrial attachment contribute to this sustainable routinizing of computer- and web-based systems for administrative activities. The consequence of the ICT committee's autonomy in financial decisions and operational responsibilities, including operating as a telecenter, have yet to be experienced. Using assessment scores as rewards and penalties has been identified as more powerful than monetary rewards (Paper **VIII**). Therefore, extracurricular activities (Paper **VIII**) turned out to most engaging. Individuals—teachers, students, and others—face factors of prestige, courage, intelligence, skill, and above all accepting collaborative learning. The barriers of funding and required skills are not very high but the potential to provide the desired skills is very high.

The purchase and training to adopt personal ICT resources (Paper **V**) faced interconnected barriers: the ability to evaluate products, trust in vendors, financial solvency, communication with cities, security risks along the way, training opportunities, and the time required for evaluation. The change agent-facilitated purchase has created some level of access in the community. They are among the very few individuals with laptops in the village, living in close proximity, known to each other, and having the opportunity to grow together in the learning process. The strategy is, in itself, a success. The smart classroom (cf. Paper **VI**) is used for the children in kindergarten, for learning rhymes, and watching kids' shows. The same DVDs are shared among all computers. The DVD contents are converted and transferred to mobile phones. These are spread in the households. These strategies, therefore, have some diffusion that the social system and norms take forward in a way that was not initially planned, researched, reflected, or anticipated. The strategies undertaken in this development intervention are not about rate of success, but about the knowledge and practice that was created by participation and for participants, the barriers that are understood and solved through negotiation, and the affordances these continue to create for ICT in learning environments.

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Paper I

ICT in Education: Secondary Technical Vocational Education and Training Institute Centered Diffusion of Innovation in Rural Bangladesh

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ICT IN EDUCATION: SECONDARY TECHNICAL VOCATIONAL EDUCATION AND TRAINING INSTITUTE CENTERED DIFFUSION OF INNOVATION IN RURAL BANGLADESH

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Abstract

Bangladesh, a developing and third world country, recognized for its microcredit success, has a favourable political environment to achieve 'Digital Bangladesh' by 2021. Government projects, public-private partnership projects, corporate social responsibility (CSR) activities and private initiatives for Information Communication Technology (ICT) for education are integrating telecenter models in secondary educational institutes. The three-fold objectives of these development projects are computer literacy for teachers and students, telecenter for community and access to better learning content or better learning. Little or no significant study had been conducted on the qualitative achievements of such projects traceable from early 2002. A secondary technical vocational education and training (TVET) institute of about 450 students in a village of about 5500 inhabitants is selected for a qualitative study using theories and methodologies adapted from different disciplines. This paper presents the plan for this action research to be conducted during August 2011 to December 2012 as part of the research project during September 2010 to June 2013.

As proponent of ICT for development, the author considers the problems of rural inhabitants (78%) living on agrarian livelihood, electricity insufficiency (47% from nation grid), socio-economic class gap and bias, lower education vs. employment association (as education for sustainability) and low access to ICTs. These might resist the intended objective of ICT for development projects. With decrease of technology obsolescence period if the technology 'domestication' is not proportionately increased, the digital divide will intensify. Bridging the digital divide (in terms of 'adaption') will become far reaching. Thus, firstly, this paper reviews different theoretical dimensions to converge towards a qualitative 'diffusion study' focusing socio-economic context. Secondly, the problems faced in implementing ICT in secondary institutions and telecenters of disadvantageous communities are reported to construct the problem boundary. Finally, the author proposes an intensive study using three different approaches to identify a preferable methodology for higher 'diffusion' or 'domestication'. Participatory Rural Assessment (PRA) will be used for identifying the achievement. Three different methodologies for diffusion include, firstly, smart class rooms and after-class telecenter model as part of a national pilot project; secondly, ICTs in co-curricular activities including self-learning and community teaching, ICT based academic administration; and thirdly, life and livelihood centred programs as part of telecentre.

In Bangladesh context, TVET institutes' students come from lower middle class or below. The motivation for these students is early employment or entrepreneurship with low capital investment. Unfortunately, TVET institutes seem to be victim of invisible bias in ICT expansion projects. Bangladesh Millennium Development Goal (MDG) progress report of 2009 shows downward index for employment. IT supports services personnel are mostly from TVET institutes. The study is expected to positively contribute and give a direction to achieve the goal using school-based telecentres.

Keywords: diffusion of innovations, participatory action research, ICT in education, telecenter, domestication, digital Bangladesh, smart classroom.

1 INTRODUCTION

Information Communication Technologies (ICT) in Education is a multidisciplinary field which has inherent prospects and problems similar to any other innovation [1], [2]. Ample evidences demonstrated ICT application benefits in educating disadvantageous communities in the third world countries especially in Africa and Asia [3]. However, information ecologists claim that the effective and efficient use of technologies is deeply rooted to "why" people choose to use a technology, the local

needs, values and norms [4]. Information architects suggest organizing information content using appropriate media suitable for the users' use context and return on investment [5]. Present telecentre models of Bangladesh[6], can be integrated with these theories.

The Peoples Republic of Bangladesh, a developing country of South East Asia, is taking nation-wide initiatives towards an envisioned "Digital Bangladesh"[7]. The population of Bangladesh is about 149.5 million [8], about 76.90% living in rural area [9], about 16 million students in 82218 primary educational institutes [10], about 6.8 million in 18756 secondary institutes among which 15785 institutes are in rural areas[11]. Digital Bangladesh initiatives are thus mostly rural focused and education centered. Government, private, corporate, public private partnership, donor projects, institute level changes and individual efforts are going in parallel to include Information Communication Technologies (ICTs) for effective utilization of "Digital Bangladesh" movement [7], [12], [13]. However, socio-economic condition of the large rural & agrarian country gets only 47% power supply from national grid with per capita consumption of 156 Kwh [14], among 11 years and above 34.2% are non-literate[15], lack of physical access to ICTs, social class gaps and bias, family resistance etc. are barriers of such initiatives. Recent ICT in education projects in developing countries attempt to achieve ICT adoption, better education, and access to information by using school-based telecentre model [16] [17][18]. Theory of diffusion of innovations [19] and theory of domestication of media and technology [20] provide ways to address some of above barriers.

In Bangladesh, the Technical Vocational Education and Training (TVET) institutes were established to create employment opportunities and entrepreneurship ability for the youth [21]. These institutes are attractive only for the lower middle and lower economic classes. For socio-economic background of family and academic environment, ICT skill level often remained low in any education stem. In this context TVET might prove sustainable for ensuring job or livelihood [22] due to higher subject association with ICT. Therefore, theories on "education for sustainability" [23], specifically livelihood or employment, for disadvantaged communities are considered in selecting a TVET institute for this project.

In the absence of significant qualitative outcome analysis of ICT usage by students and surrounding community as a contribution of various development projects, this study attempts to deploy and compare three alternative approaches to diffuse ICT in the school and the village it is situated in. This study will also identify contribution in millennium development goal targets, namely employment to population ration (target 1B), internet and cellular subscriber per 100 population (target 8F) [24]. This paper presents the initial plan for this action research to be conducted during August 2011 to December 2012 as part of the research project during September 2010 to June 2013.

2 RESEARCH OVERVIEW

2.1. Background of the Study

In October 2010, Bangladesh government, Bangladeshi NGO DNet and Volunteers Association of Bangladesh (VAB) initiated a three-year public-private initiative to establish 100 Smart Class Rooms (SCR) as Computer Literacy Center (CLCs), in 100 secondary schools of rural areas[25]. The project aims at ensuring participation from local community for financial initiatives; teacher training; design, develop and adapt English, Science and Geometry teaching-learning using DNet created content; provide access to community people after the school hour. The expected outcome is ICT education for 15000 students, ICT based learning for 35000 students, teacher training for 600 teachers and above all access for community. During 2004 to December 2009 with support from VAB for Computer Literacy Program (CLP)[26] DNet had established and trained through 109 CLCs in 39 districts in Bangladesh[27]. There is significant number of different telecentre models including school-based telecentre models in Bangladesh. Apart from frequently available outcome analyses using descriptive statistics and success reflecting case stories, there is little or no evidence of qualitative study on the challenges and contributions of these telecentres. This action research along with a qualitative study is expected to contribute both the theory and practice of school-based telecentre models.

The author believes that Technical vocational institutes should have been considered as priority target group for these projects. Furthermore, alternative approaches to ICT inclusion in Education should have been explored. With the decrease in technology obsolescence period technology adoption and utilization should increase. A rural Bangladesh context specific effective ICT diffusion process around school based telecentre has not being identified, which this research attempts to explore.

2.2. Significance of the Research

ICT literacy is becoming pre-requisite to enabling citizens with quality information access and enabling students with education for sustainability. ICT development being very fast, literacy and adoption training is required to be proportionate. Socio-economic and socio-cultural condition might not embrace ICT for education. The Information ecology and information architecture in a social system are dynamic and continuously changing. Co-curricular activity oriented and community participated requirements focused ICT selection and training might have greater impact, which are required to be explored. Similar to failure of enterprise resource planning (ERP) software deployments, if national level initiatives fail to include target group participation, loss could be disastrous [28]. This research is expected to contribute to this national level issue.

Employment or livelihood increase is one of the millennium development goals (MDG) of Bangladesh, where the country is lagging behind [29]. Devised school-based telecentre model is expected to increase sustainability of education and also by contributing to employment or livelihood increase.

2.3. Review of Literature

An extensive literature review will be conducted on the following interconnected theoretical areas or keywords for elaboration of methodology and research plan. Some of the related papers are shown in Tab. 1.

Table 1. Theoretical dimensions of the research for review of literature

Keywords/Terms	References
Diffusion of Innovation	[19], [30], [3], [31]
Domestication	[20], [32]
Information Ecology, Cultural Ecology	[4], [33], [34]
Information Architecture	[5]
Ecopedagogy	[35], [36]
Information and Communication Technologies (ICTs)	[37], [38], [39]
ICT in Secondary Education	[40]
Technical Vocational Education and Training (TVET)	[22], [21]
Education for sustainability (livelihood or employment)	[41], [42], [23], [43]
Participatory Action Research (PAR)	[44]
Participatory Rural Appraisal (PRA)	[45]
Telecentre	[6], [38]
ICT-based Curricular, co-curricular and extra-curricular activities in School	[46], [47], [48], [49], [50]
e-readiness or e-preparedness	[28]
Digital divide	[47], [51], [52]

Diffusion of innovation being the core objective of this action research, terminologies associated with ICT and disadvantaged rural community will also be elaborated. As [53] summarizes [54] as “basic model of innovation” by “Firstly, any new form of behaviour must yield benefits that outweigh the costs or disadvantages (= “readiness” or R). Secondly, the new form must be legitimised, i.e., it must be culturally (ethically, morally) acceptable (= “willingness” or W). Thirdly, there must be adequate means, though not necessarily of a technical nature, to implement the new form (= “ability” or A). Moreover, the three preconditions must be met jointly for the new behavioural form to succeed. Hence, a success S can be expressed as $S = R \cap W \cap A$. This expression furthermore defines a bottleneck model, since the failure of satisfying one condition prevents the innovation from breaking through, even if the other two preconditions are met.” The study would attempt to qualitatively identify which of these three variables could be facilitated by the adopted telecentre model.

2.4. Research Problems

Due to various barriers the challenge is, “How much of ICT can be put into practice using school-based telecentres?” This question is further divided into following from the viewpoint of disadvantaged rural communities of Bangladesh (Fig. 1).

- Which information communication technologies (ICT) get diffused and why?
- What are the e-readiness, willingness and readiness requirements and how those can be satisfied?
- How curriculum and pedagogical adaptations are occurring?
- How co-curricular or extra-curricular activities can be used for ICT diffusion?

- How ICT in academic administration can be made acceptable to all?
- Does ICT in TVET directly contribute to employment or livelihood?
- Does the telecentre model improve local information support system or information ecology?

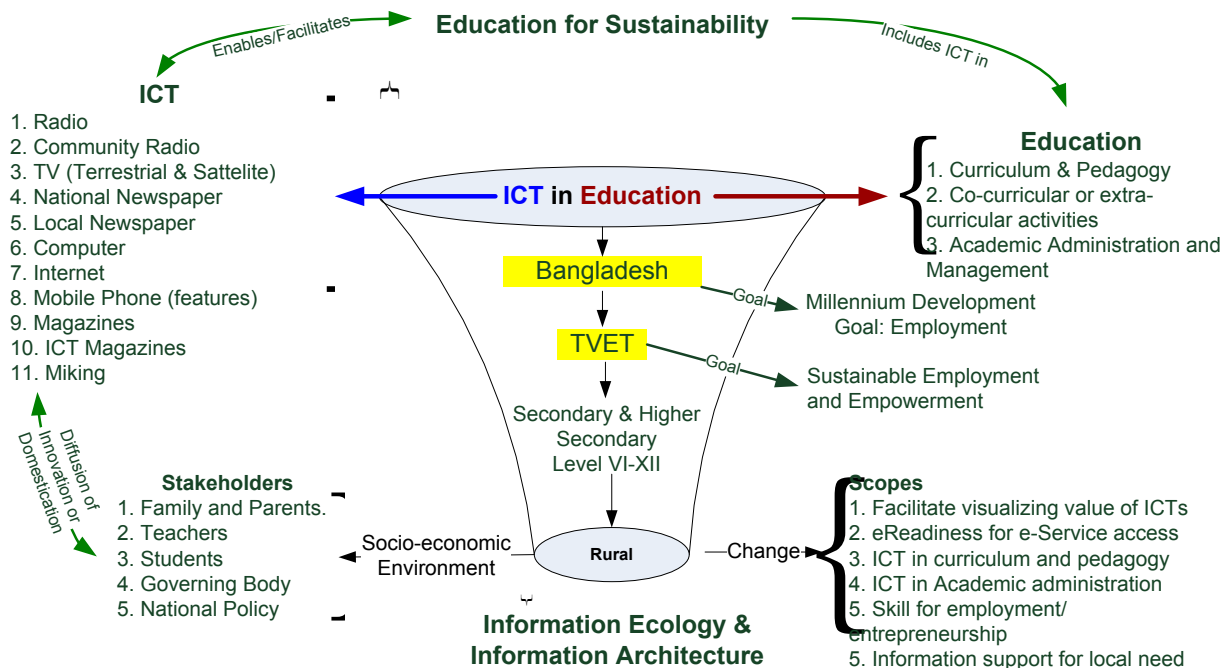


Fig. 1. Relationship among theoretical dimensions, project goals and scope

2.5. General Objectives

The general objectives of this “ICT in Education” research on “disadvantaged communities” is

- 1) to qualitatively compare three ‘diffusion communication’ [19] strategies using diffusion of innovation theory focusing ICTs in a vocational school
- 2) to develop a specific methodology of Participatory Rural Appraisal around the school
- 3) to conduct Participatory Action Research for integrating ICT training for Education for sustainability (livelihood/employment)
- 4) to develop a diffusion communication through co-curricular/extra-curricular activities
- 5) to identify factors affecting integration of ICT in curricular activities and academic administration
- 6) to qualitatively study the response of teachers, students, parents and rural community towards technology integration in school
- 7) to study the information ecology in current rural setting

2.6. Limitations of the study

Unpredictability associated with time and cost issues of participatory action research are core limitations.

3 PROPOSED RESEARCH METHODOLOGY

3.1. Baseline Study: Participatory Rural Appraisal

A participatory rural appraisal (PRA) will be conducted following the present practice by Bangladesh Academy for Rural Development (BARD)[55] and Rural Development Academy (RDA) [56] . Questionnaires will be developed to suit the context shown in table 3. Senior students of the TVET institute will be grouped in team of five according to their residence in *para* (zones of village) and conduct PRA in their own *para*. PRA experienced students from a private university in Bangladesh will work with each team. The study typically takes 10 working days including 2 working days of training. The outcome would be a baseline study on existing ICT environment in the village.

3.2. Diffusion Communication

3.2.1. ICT in Curricular Activities and After-school Telecentre

A Computer Literacy Center (CLC) will be developed along with Smart Class Room (SCR) under Computer Literacy Program (CLP) [26] under the pilot program for ICTs in Education under Public Private Initiative[25]. In a SCR, students will learn through the use of interactive educational CDs and the Internet. The CDs prepared by experts will allow quality classroom education for the students, and at the same time, become useful tools for training local teachers in better teaching methods.

3.2.2. ICT in Co-curricular or extra-curricular activities and academic administration

The Duke of Edinburgh's (DofE) Award International Association [57] coordinates the community based service award program as part of co-curricular activities of schools to universities in Bangladesh since 2009 [58]. Two teachers will receive award leader training from the DEA trust in Bangladesh. Students enrolled will have to spend at least 6 months and spend certain amount of time to fulfil the four criteria, which are service, adventurous journey, skills and physical recreation. Under 'skills' category, students will be provided with Student's manual, "Esho Computer Shikhi" (Let's Learn Computer) and Computer Teaches Everyday English (CTEE) of DNet. Under 'Service' category, students will teach their family member(s) the same ICT skills to do self learning using computer. Some students may take some hours to do gain 'skill' and provide 'service' at the telecentre. Some students will be given skills training for providing free troubleshooting and support services to people. For the 'adventurous journey' students will take a trip to the capital to visit largest computer market and mobile phone market. On return 'an essay writing' competition will be held select the best article on 'a day with technology' where an imaginary story of using various ICT devices and features will be described as part of a regular day. DofE activities are supposed to be free to students to choose. However, due to resource constraints if students are facilitated with new opportunities, students enjoy and participate spontaneously.

Community Radio Operation by School for Society (CROSS) is a program of BNNRC [59] which will be part of the DofE activity for a test basis, according to the given regulation of Bangladesh.

All teachers will be given in-house training to use basic office applications for records keeping. For accessing board results through internet training will be provided on basic internet browsing. Searching university admission information for their students, websites for searching job scopes, writing CV, writing a testimonial and writing Bangla using phonetic keyboard etc. will be introduced to teachers. Official record keeping will be enforced.

3.2.3. ICT for life and livelihood

Following programs will be initiated in the village

- A. Pallitathya (rural information) Help Line [59] which provides villages a set of mobile phone numbers to make a specific query on any livelihood matters or to send some urgent information associated with the program. Access to CD based content and pallitathya.org website browsing will be also facilitated through the telecentre.
- B. Infolady: The "Infolady", is a new concept evolved from the experience of 'Mobile Lady', coined and operated by DNet [60]. The mobile lady is equipped with a netbook (e.g., CMPC' or EEE PC) is loaded with offline Bangla livelihood content and audio-visual content, internet modem, headphone, webcam, digital camera, mobile phone and some other light equipments like weight measurement machine, blood pressure machine, pregnancy test kit, sugar test kit etc. Women have been chosen for the infolady initiatives since they have a better access to the conservative households as well as for the handicapped and illiterate. Pallitathya help line is part of the role of infolady.
- C. "Abolombon: Empowering People through Improved Access to Livelihood Information, Governance and Human Rights"[61]. Information support will be provided through CD version of the website abolombon.org accessible through the telecentre.
- D. Computer Teaches Everyday English (CTEE) will be available for all village residents and students during the after school hours at the telecentre.
- E. Access to information for Improvement of Rural Livelihood [62]
- F. Female teachers and students will be provided a handbook written in Bangla, titled "Technology and Women", to give realization on the role of domestic stakeholders, technology for empowering women and technology for reducing poverty [63].

3.3. Follow-up Study: Participatory Rural Appraisal

A follow-up study will be conducted after one year of initiating the action research. A PRA study will be repeated. An extensive qualitative study will be conducted throughout the study duration. Case stories will be reported as part of the qualitative study. Methodology of qualitative study plan is in progress at the time of writing this paper.

Table 3. Participatory Rural Assessment (PRA): Addressing ICT context

Factors influencing use of ICTs	Access to Technology	Human Capacity	Enabling Environment
Social Classes/families	<ul style="list-style-type: none">Physical accessAppropriateness of technologyAffordability and use	<ul style="list-style-type: none">Human capacity and trainingLocally relevant content, application and servicesIntegration into daily routineSocial appropriation	<ul style="list-style-type: none">Socio-cultural factorsLocal and micro-economic environmentPolitical will & public supportLegal & regulatory framework
Academic Institution			
Personal			
Other Sources			

4 RESEARCH LOCATION AND RESOURCE ALLOCATION

A secondary technical vocational education and training (TVET) institute of about 450 students in a village of about 5500 inhabitants is selected for a qualitative study using theories and methodologies adapted from different disciplines. This action research will be conducted during August 2011 to December 2012 as part of the research project during September 2010 to June 2013. The follow-up study will be conducted in December 2012.

The research will be supported by Bangladesh NGOs Network for Radio and Communication (BNNRC)[64] and Development Research Network (DNet)[65].

5 EXPECTED OUTCOMES OF THE PROJECT

- Adopted school-based telecentre model for rural secondary educational institutes
- Qualitative analyses and understanding on three different diffusion communication strategies.
- An ICT diffusion process through co-curricular activities for academic institutions
- A school-based participatory rural assessment (PRA) methodology adoption for local information repository creation
- Understanding on TVET school-based telecentre model's contribution to livelihood or employment

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Paper II

A Theoretical Framework Mapping Barriers of Integrating and Adopting Educational Technology

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A THEORETICAL FRAMEWORK MAPPING BARRIERS OF INTEGRATING AND ADOPTING EDUCATIONAL TECHNOLOGY

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In the field of educational technology, a decades-long research question is: what barriers exist in integration and adoption of information and communication technology (ICT) in education educational technology? The intensity of integration and the rate of adoption are significantly low and the interdependencies of barriers within the complex education system are under-represented in the existing categorization of the barriers. So, based on an interest in re-categorizing, mapping, and analyzing the barriers from a transformative paradigm, this study builds on a hermeneutic method of review on 228 peer-reviewed articles. Existing categorizations of barriers are identified and an analysis is conducted to establish a macro-meso-micro level approach as a theoretical framework representing the education system and its external environment. A second analysis identifies, maps, and analyzes the barriers in existing literature by using the theoretical framework. The paper manifests that the macro level's (national) pre-set goals conflict with expectations from the meso level's (institutional) educational technology integration. Moreover, factors at the macro and meso levels influence the micro-level (individual) adoption decision. Instead of "system blame" or "individual blame", an integration and adoption approach should consider national holistic view for careful strategic changes in policies, procedures, and practices at each decision level of the educational system and related external systems.

Keywords: educational technology; ICT in education; integration; adoption; barriers; challenges; macro; meso; micro.

1. Why a Holistic View Looking at the Relationships between Micro, Meso and Macro Level Barriers?

In the field of educational technology, a frequently raised question is: What barriers exist or might occur in situations of integration and adoption of information and communication technology (ICT) in relation to education by both individuals and educational organizations? In addressing this question, a significant amount of literature

is dedicated to exploring, identifying, categorizing, relating and addressing barriers. This paper began with an objective of conducting a review, but the transformative paradigm of the researchers led to mapping the barriers into a theoretical framework to represent a holistic view. The findings from 228 initially selected articles showed that current literatures use the term barriers interchangeably with obstacles, challenges, and hurdles. In addition, barriers are involved with two overlapping processes and concepts: integration (Belland, 2009; Lloyd, 2005) and adoption/diffusion (E. M. Rogers, 1995). In addition, to facilitate the processes of integration and adoption, the researchers categorized and analyzed these barriers using different terms. To present a pattern, the categorization include: conditions for assessment focus versus learning focus (McGarr, 2009), macro-meso-micro level barriers of the education system (Balanskat, Blamire, & Kefala, 2006; Tondeur, van Keer, van Braak, & Valcke, 2008), teachers' extrinsic or first-order barriers and intrinsic or second-order barriers (Albirini, 2006; Ertmer, 1999; Snoeyink and Peggy A. Ertmer, 2001), school-level barriers and teacher-level barriers (A. Jones, 2004), direct and indirect barriers (Hew & Brush, 2006), material and non-material barriers (Pelgrum, 2001), and other ways of categorization (Bingimlas, 2009; Ertmer, Ottenbreit-Leftwich, Sadik, Sendurur, & Sendurur, 2012; Hew & Brush, 2006). From these categorization approaches, the current paper argues for and builds on the macro-meso-micro categorization as a theoretical framework for mapping the interdependencies among the barriers.

The reviewed articles emphasize one level of barriers and under-stressed accounting for the relationships between the levels in the complex systemic educational processes. Barbera et al. (2012, p. E55) affirms that "There is a need to take time into account not only in micro-level research but also at the meso level (i.e., curricular) and macro level (i.e., organizational). Understanding the impact of innovation on curricular and organizational change and how they affect each other is of the utmost importance. Research is needed to effectively improve methods that can provide evidence of growth over time and can support decision making and policies with respect to ICT adoption and implementation." In addition, Ertmer (2005, p. 36) concludes that despite successful technology integration, "high level technology use is surprisingly low, suggesting that additional barriers, specifically teachers' pedagogical beliefs may be at work" – in the micro level. Moreover, pedagogical belief about the use of ICT in relation to education is developed through early childhood to secondary education; therefore, customized facilitation should be provided to teachers for changing pedagogical action (Belland, 2009). Furthermore, Ertmer (1999) stressed that any of the barriers (among them are personal fears, technological and logistical issues, organizational and pedagogical concerns) alone can significantly impede meaningful ICT use in classrooms, so, a holistic pattern of barriers and their relationships within the education system and its environment should be formulated. Thus, current paper argues for macro-meso-micro categorization as a theoretical framework and analyzes the relationships among barriers through a mapping exercise.

To achieve the objective, methodology of the literature review is discussed (Section 2); existing barrier-categorizations are analyzed and the theoretical framework is argued for macro-meso-micro categorization of the barriers (Section 3). Then, the theoretical framework is elaborated (Section 4). Subsequently, the barriers and their relationships are reviewed and analyzed through a process of mapping into the theoretical framework (Section 5). Finally, a summary of the holistic view of barriers in the educational system at national level points towards scope of future work.

2. Methodology for Selecting Data

The review methodology is based on the different stages of the hermeneutic cycle shown in Figure 1 (Boell & Cecez-Kecmanovic, 2010, p. 7). The hermeneutic circle enables an interpretive understanding. The iterative stages involved identifying (central terms, main authors, core journals), refining, searching (database dependency, by field, and using operators), sorting (citations, relevance, date), selecting (title, abstracts, keywords), acquiring (availability, inter library loan, and language), and reading (increasing understanding, note keeping, referencing) (Boell & Cecez-Kecmanovic, 2010, p. 7).

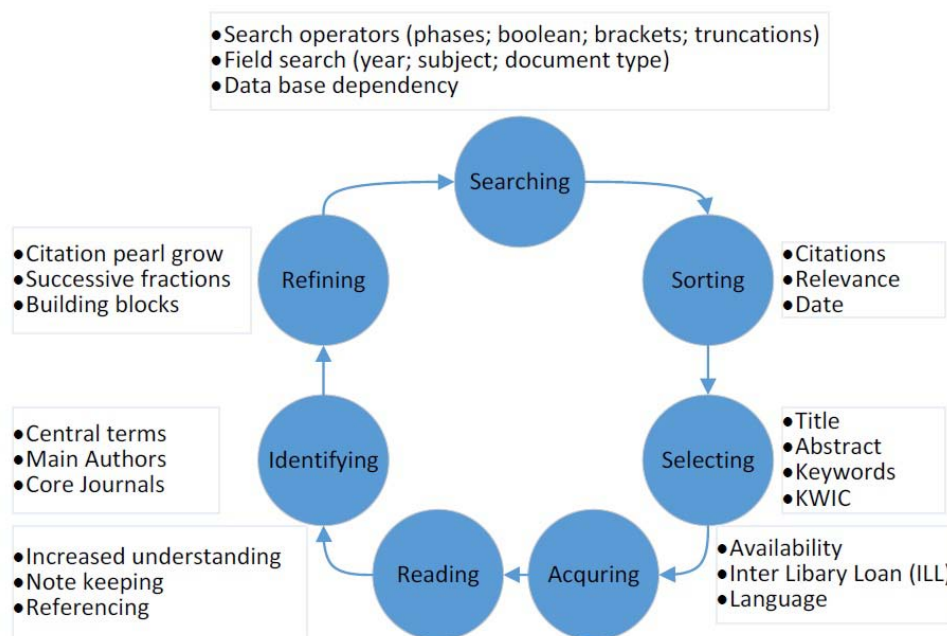


Figure 1. The hermeneutic circle. (Boell & Cecez-Kecmanovic, 2010)

The literature study was based on the following keywords: educational technology, ICT in education, integration, assimilation, adoption, diffusion, domestication, barriers, challenges, obstacles, and hindrances. It was emphasized that the selected study reported on the terms *barriers* or *challenges* or *obstacles* of the *integration* or *adoption* of

educational technology or *information and communication technology (ICT)* in education in the title, abstract and keywords. The searching stage included three databases: ERIC, SciVerse (the portal for Scopus and Science Direct), and Google Scholar. These databases were selected through multiple searches in a pool of different databases and by comparing highest appropriate returns in the first page of 10 articles. First, 213 peer-reviewed journal articles and book chapters were selected from ERIC, which also had the easiest search functionality and rich literature on educational technology. Second, an additional 15 relevant articles were selected from SciVerse. Third, for specific papers in the refining part of the process, searches were done using Google Scholar. An initial field search criterion was to set 2004 as the starting year because the statistical trend of publication was significantly higher from this year. This study does not involve any article published before 1991.

3. Categorization of the Barriers

This section analyzes the existing categorizations of barriers (see Table 1) in the integration and adoption of ICT in education. The analysis establishes a macro-meso-micro level approach as the basis of the envisioned framework and to further identify, describe and map the kind of barriers to be addressed in the theoretical framework.

Table 1

Existing categorizations of barriers in the integration and adoption of ICT in education

Categorizations of Barriers	Literatures
<i>Micro level, meso level and macro level</i>	(Chan, 2011; Khalid & Nyvang, 2013)
<i>Teacher level, school level and system level</i>	(Balanskat et al., 2006)
<i>Extrinsic or first-order and intrinsic or second-order</i>	(Albirini, 2006; Ertmer, 1999; Snoeyink and Peggy A. Ertmer, 2001)
<i>Material and non-material barriers</i>	(Pelgrum, 2001)
<i>Teacher-level barriers (confidence, competence, and resistance to change & negative attitude) and school-level barriers (time, training, accessibility, technical support)</i>	(Bingimlas, 2009)
<i>Resources, knowledge and skills, institution, attitudes and beliefs, assessment, and subject culture</i>	(Hew & Brush, 2006)
<i>Direct and Indirect</i>	(Hew & Brush, 2006)

The macro-meso-micro approach to categorization is not uniformly defined, interpreted, and applied in educational technology literatures (Balanskat et al., 2006; Chan, 2011; Czerniewicz, 2004; C. Jones, Dirckinck, Holmfeld, & Lindström, 2006; Looi, So, Toh, & Chen, 2011; Triggs & John, 2004). For instance, the barriers at the micro level are either associated with teachers as individuals or the classroom as an environment. Looking at the macro level, the barriers are grouped either at the district or at the state level.

The literature shows a common trend and understanding for defining the educational technology application levels; that is, the micro level involves the classroom settings, the meso level encompasses the institutional level, and the macro level includes the national

bodies associated with education and ICT. Chan (2011, p. 176) argued that the macro (national) level provides the actual initiative, which involves the processes of national education policy, curriculum and ICT reform, and cultural beliefs.

Balanskat et al. (2006) grouped the integration and adoption barriers into teacher level barriers (micro), school level (meso), and system level (macro). Here system level is defined as the existing assessment and evaluation methods. The article argued that “teachers are under pressure in reaching the standard objectives and fear that schools using ICT will be less performing than traditional schools” (Balanskat et al., 2006, p. 58).

Looi et al. (2011) studied the educational system factors of the policy imperatives governing Singapore’s educational landscape (macro), the contextualized classroom-based interactions (micro), and the socio-cultural environment where learning takes place (meso).

Resnick (2010) claimed that educational technology integration and adoption processes bring changes at three different levels of the “nested learning systems”; the current paper clarifies the nested levels of barriers within classroom (micro), school (meso), and district level (macro). The macro level is dependent on the administration system atop the school level.

In researching computer-supported collaborative learning (CSCL) design, C. Jones et al. (2006) applied a similar concept by considering single or small groups as micro level, institutions as meso level, and beyond institutional scope as macro level. In addition, Chan (2011, p. 176) reported that experiences from knowledge-building classroom innovations in the schools in Hong Kong within CSCL include the macro-context of educational policies and educational reform, the meso-context of a knowledge-building teacher network, and the micro-context of knowledge-building design in classrooms.

Czerniewicz (2004) suggested, from a South African experience, that the barriers might be categorized at classroom (micro-) level, institutions (meso-) level and national (macro-) level.

Triggs & John (2004) used the macro-meso-micro levels as “layers of communities” of practice in their project, where the project design community is at macro level, meso level consisted of the community of teachers from partner schools, researchers and teacher educators from the university, and the micro level involved the community of individual teachers’ classes.

This paper brings common understanding on the macro, meso, and micro level categorization of the barriers, either mentioned explicitly or viewed implicitly as the theoretical framework of the existing educational technology literature discussed above, which includes the communities of practice, CSCL, and categorization of barriers. In addition, explicit differences (see Table 2) are identified in defining or labeling the concepts of macro, meso, and micro.

This paper generalizes the definition, labeling, and empirical applications of the discussed literature and proposes that the macro, meso, and micro levels depict the following respectively: state or national or system level (macro); educational or organizational entity or institution (meso); teachers, students, parents, staff, or other

stakeholders of the entity or institution (micro). In addition, the concept of considering the classroom as the micro level is discarded, because, from the transformative paradigm, the authors of this paper argue that the classroom level does not hold a systemic identification in the power structure or in relation to the education system. However, teachers and other stakeholders as individuals are the decision-makers of the system. Apart from teachers, other stakeholders are not considered with sufficient emphasis (Belland, 2009). Therefore, the framework labels and applies the micro level as stakeholders of institutions, i.e., individuals.

3.1. *Argumentation for the macro, meso, and micro as the theoretical framework*

This section takes its point of departure from the transformative paradigm, on which foundation the researchers “believe that inquiry needs to be intertwined with politics and a political agenda” (Creswell, 2003, p. 9). In addition, transformation should include an action plan for change “that may change the lives of the participants, the institutions in which individuals work or live, and the researcher’s life” (Creswell, 2003, pp. 9–10). So, from this viewpoint, the integration of technology in the education system brings along a transformation that faces the barriers. Thus, the authors argue that the framework for addressing the barriers faced in the transformation process, which is associated with the technology integration in education, should be involving the existing power relations in the education system.

Some of the literature categorizes teachers’ changes or barriers to integrating technology into their curricula as extrinsic or first-order and intrinsic or second-order (Ertmer et al., 2012; Ertmer, 1999, 2005; Snoeyink and Peggy A. Ertmer, 2001). *First-order barriers* to technology integration are described as being *extrinsic* to teachers; they include lack of access to computers and software, insufficient time to plan instruction, and inadequate technical and administrative support. In contrast, *second-order barriers* are *intrinsic* to teachers and include beliefs about computers in teaching, established classroom practices, and unwillingness to change. Ertmer (1999) described the first-order barriers as “incremental, institutional” and second-order barriers as “fundamental, personal”; the article argued that teachers and teacher educators crossed the stage of adoption decision (“to use or not to use computers”) and presently deal with the integration process (“when and how to use computers in meaningful ways”). Considering the concept of teachers’ *external and internal barriers* (see Table 2) constrains the complexity of education system, which has an external environment that poses some of the barriers. To elaborate, the transformation process through ICT in education may have power to diffuse the innovations and change the process but not the external environment as such. In addition, this paper takes the concept of first-order or “incremental, institutional” barriers but applies it to the educational system itself and to each of its levels, i.e., macro, meso and micro – each with different policies and power relations in the system. That way, any of the meso or macro levels are *extrinsic* to the individual (micro level), which includes all the stakeholders of the education system; although a technology adoption (E. M. Rogers, 1995) decision (whether collective, authoritative or

optional), which is undesirable to the intended adopters (teachers, administrators, students, and other *individuals*), might pose *intrinsic* (i.e., *fundamental, personal*) barriers. The proposed framework emphasizes on both *individual and organization adoption factors* (E. M. Rogers, 1995), particularly in the education system (Belland, 2009) and learning contexts (Cilesiz, 2008).

Table 2

Adapting extrinsic-intrinsic barriers within macro-meso-micro framework

Ertmer's terminology			Applied understanding
First-order	Extrinsic	Institutional, incremental	External to education system, Internal to education system levels of macro and meso
Second-order	Intrinsic	Fundamental, personal	Internal to individuals stakeholders in the education system

It might be argued that second-order or intrinsic barriers are associated with both the technology integration process and the nature of adoption decision process. The natures of these two processes determine the association of the intrinsic (i.e., *individuals' or micro-level*) barriers with the other (i.e., meso-, macro-, and external) levels of barriers. Regarding integration, Ertmer supported the idea that “second-order barriers must be addressed prior to, or at least in conjunction with, the attainment of higher levels of integration (1999, p. 53). Bingimlas also supported the argumentation that “extrinsic barriers as pertaining to organizations rather than individuals and intrinsic barriers as pertaining to teachers, administrators, and individuals” (2009, p. 237).

Pelgrum (2001) surveyed lower secondary schools' technology experts, teachers, and principals from 24 countries worldwide to indicate major obstacles or barriers to the integration of ICT in education; the top 10 obstacles (which were selected by an average of more than 50% of respondents across countries) were categorized as *material* and *non-material* conditions. Topics addressed in the survey include curriculum, infrastructure, staff development, management and organization, and innovative practices (Pelgrum, 2001, p. 167). It might be argued that the root causes of each of these material and non-material barriers could be from one or multiple factors of the proposed macro, meso, and micro levels. In addition, Pelgrum (Pelgrum, 2001, p. 164) stated that “*Forces that operate on the micro and meso level of the education system (that is at schools and in classrooms) may be influential in bringing about changes that are beyond the direct control of ministries of education*” and also reported that the transition from industrial to education society requires changes among actors in education, that is, the *individuals* at the micro level. This supports the proposed framework by arguing that the micro and meso levels are situated within an environment; it is the situated external environment that is beyond direct control of the macro (i.e., national) level and contains forces of resistances against the change processes.

Hew and Brush's (2006) review paper classified the barriers into six main categories as follows: (a) resources (40%), (b) knowledge and skills (23%), (c) institution (14%), (d)

attitudes and beliefs (13%), (e) assessment (5%), and (f) subject culture (2%). In addition, these categories are further classified as *direct* and *indirect*. The four *direct barrier categories* are: (a) teachers' attitudes and beliefs towards using technology, (b) teachers' knowledge and skills, (c) institution, and (d) resources. Hew and Brush looked for congruency in the findings of Rogers (2000, pp. 459–461) and mapped Rogers' 10 barrier categories within the above mentioned 6 categories (Hew & Brush, 2006, p. 241). Except for “funding,” the barrier categories of Rogers are present in the categorization model of Hew & Brush.

To indicate the indirect effect through the direct categories Hew and Brush states: “Technology integration is also thought to be indirectly influenced by the subject culture and assessment. Subject culture directly affects technology integration via teachers' attitudes and beliefs, and the institution” (2006, p. 232). While direct and indirect categories represent dependency relationships among the barriers, the institutional (meso) and teachers (micro) levels involve the related power relationship or the decision-making factor. Therefore, whether the barrier is direct or indirect, the prerequisite issues are who or what holds the power to change, which calls for the systemic view of macro-meso-micro labeling of barriers.

Khan, Hasan, & Clement (2012) reviewed the barriers from the developing country perspective, using Bangladesh as an example, and grouped (without explicit categorization) the barrier in the following manner: ICT supported infrastructure (lack of electricity, dependable internet connectivity) and lack of resources (availability, supply, maintenance, and up-to-date equipment and accessories), insufficient funds, vision (national and institutional levels), and plan (government and school levels), political factors, social and cultural factors, corruption, teachers' attitudes and beliefs about ICT, lack of knowledge and skill, and lack of time. All of these except corruption are also represented in other frameworks as barriers (Hew & Brush, 2006; Pelgrum, 2001).

In light of the above discussion, the authors established the significance of a theoretical framework (macro, meso, and micro level) based on a paradigmatic view of the power relationships for change in the education system. The argumentation for the framework is congruent to Taylor (1997), who concluded that a framework of macro-meso-micro level is important in light of policy research and stressed that “the importance of exploring the linkages between the various levels of the policy process with an emphasis on highlighting power relations” (Taylor, 1997, p. 32). Educational technology adoption and integration fundamentally depends on ICT and educational policies, which are decided and implemented at the levels of a nation (macro), an institution (meso), and an individual (micro). For instance, the personal policy of the educational stakeholders (micro level), whether they are teachers or parents – these hold the power relationships. It is those relationships of policies and powers among the levels in the education system of a country that govern how the barriers are experienced in the adoption and integration of ICT in education.

4. The Theoretical Framework Representing Macro-Meso-Micro Levels

The previous section discussed that origins of the barriers are situated within a country's context and are entwined within the education system; so the framework (see Figure 2) illustrates a two-fold categorization of interdependent barriers.

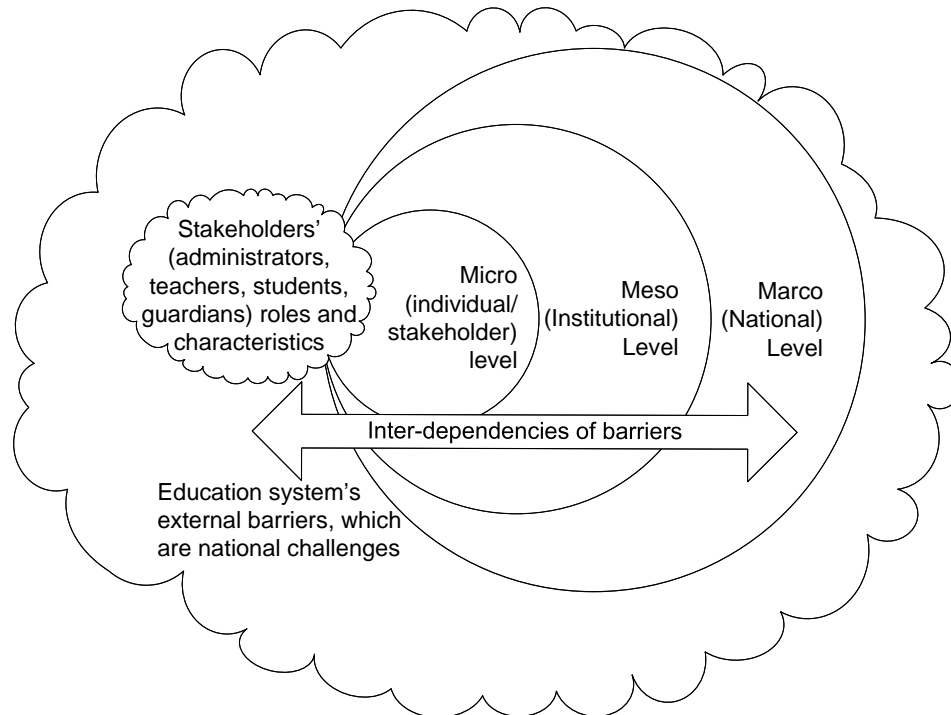


Figure 2. Theoretical framework of barriers in educational technology integration and adoption. Source: (Khalid & Nyvang, 2013)

First, the barriers can be divided into two broad categories: a) internal or system's barriers and b) external or system container's barriers. Second, an education system's stakeholders play the role on three tiers: national and regional (macro), institutional (meso), and individual (micro) levels. These two-fold categorizations suggest that the power relationships among stakeholders in an education system and the process of vertical and horizontal communication fundamentally involve a country's holistic environment (Khalid & Nyvang, 2013).

The two categories in the framework involve two claims.

The first claim is that the barriers within the discipline of educational technology are constrained within a country's context and might not be generalized at the international level. The roles at the individual level bear and exert the properties of the social, cultural, institutional and other attributes of the country. "Research has shown that technological innovations work in some schools and not others because of contextual factors. The complexity of the educational enterprise and other social, economic and organizational factors are largely neglected in the hast to promulgate computers in education" (Tang &

Ang, 2002, p. 460). In addition, significant levels of complexities exist in the power relationships of the barriers (see, for instance, Hew & Brush, 2006), which are not beyond the scope of sensitivity to situational cases. Therefore, the framework's "channel or connectors of barriers" (see Figure 2) encapsulate the complex dependencies of barriers experienced by the stakeholders, who play their roles within the multi-tier education system and the external environment. It depicts that, in the case of change processes, the system's stakeholders are required to differently address the external barriers, which are not within their direct scope and authority.

The second claim is that the complex relationship of barriers depends on the *innovation-decision* processes at the individual and organizational level (E. M. Rogers, 1995). In addition, the current educational technology literature involves a risk of "*pro-innovation bias*" (E. M. Rogers, 1995). This bias originates from the assumption that change agents or change initiatives are faultless, and targeted adopters (individuals or organizations) are responsible for any anomaly in the diffusion process. In the educational technology literature "the issues of differences in usage and interpretation by the receivers were largely ignored" (Tang & Ang, 2002, p. 460).

Therefore, while mapping into the framework, some of the barriers could not be mapped into one level or could not be separated from interdependencies. In such cases, the barriers are mapped in multiple levels or dimensions, so the framework addresses the two claims. First, solving or circumventing a barrier might involve decisions at multiple levels in the educational system, which involves multiple tiers of policies and power relationships. This "power" is the *innovation-decision*, in Rogers' (1995) term. The framework maps each of the barriers according to the innovation-decision relationships in a national context. Secondly, the inherent pro-innovation bias leads to "individual blame" and "system blame" (Melkote & Steeves, 2001; E. M. Rogers, 1995), and the framework maps the barriers into both individual and system levels eliminating the blame.

The internal barriers can be broadly categorized as individual (stakeholders') level and organizational (education system) level. The educational system is further divided into two levels of organizations, i.e., educational institutes as meso level and national bodies as macro level. The individual (micro) level and organizational (meso and macro) level attributes of the adoption of innovations are discussed by the theory of diffusion of innovations (E. M. Rogers, 1995), the theory of planned behavior (Ajzen, 1991), and the hybrid innovation framework (Gallivan, 2001). The diffusion theory and the innovation framework argue that the organizational change process, which is focused on the innovation, involves three types of attributes: innovation attributes, organization attributes, and individual attributes (Gallivan, 2001, p. 60; E. M. Rogers, 1995). These attributes can have the property of positive, negative or neutral effect on the integration and adoption process. The current paper deals with the attributes that have negative effect on the desired change; these attributes are being called barriers.

5. Mapping Barriers of Adoption and Integrating ICT in Education

5.1. Education system's external barriers

The external barriers of the education system are barriers such as *lack of electricity* and *poor internet speed* within a country (Khan et al., 2012). In addition, external barriers are related to social and cultural aspects, as *lower social status of women* (Sharma, 2003), *gender differences* (Shapka & Ferrari, 2003; Volman, van Eck, Heemskerk, & Kuiper, 2005), and *difference between mother-tongue and the language of ICT interface*, and *low English proficiency* (Khan et al., 2012, p. 70; Sharma, 2003, p. 514). The gender differences are related to more than one aspect, as further discussion also illustrates. In developing countries women find *little time for ICT* because they are busy with domestic chores and *insufficient level of education* is an ICT-adoption barrier (Khan et al., 2012). (Khan et al., 2012; Sharma, 2003)

Pierce and Ball (2009) explains the *demographic* factors as follows: *Age* may influence the perceived norm for using technology for teaching a specific subject in an institution, e.g., younger and older teachers are in favor and middle-aged teachers are not. In relation to *gender*, female teachers may be more likely to perceive themselves as technologically less competent (ability to motivate students, troubleshooting, provide deeper understanding). In relation to *region*, school leaders from regional or rural institutions are less likely to expect teachers to use technology in their teaching practices as opposed to the metropolitan or urban school leaders.

5.2. Education system's internal barriers

The education system's internal barriers resist ICT adoption at the levels of micro, meso, macro interdependencies of the levels, and at multiple levels at a time. So, the analysis of the barriers is broadly divided into single-tier barriers (e.g., micro, meso, macro) and multi-tier barriers (e.g., micro and meso, meso, and macro, etc.). However, assigning a barrier to a specific level is context-sensitive, which formed the basis of the cited article. Therefore, mapping of the barriers as follows is rather a point of departure for further diffusion interventions and categorizing any barrier is subjective to objective context.

5.2.1. Micro (Individual) level barriers

Following the work of Pierce and Ball (2009) on teachers' perceived barriers, Ajzen's (Ajzen, 1991) theory of planned behavior (TPB) can be used to explain the adoption decisions of stakeholders in three categories: personal attitudes to change, subjective norm or social factors, and perceived behavior controls. The social factors can be either external to a society or internal to an educational organization. From the literature, individual-level barriers can be divided into attitudes of teachers and administrators, students, and parents.

Teachers' and administrators' attitudes and belief

- Negative attitude of teachers, principals, ICT coordinators, etc. (Tondeur et al., 2008).
- Teachers' attitudes towards computers are directly related to principals' attitudes (Pierce & Ball, 2009).
- Administrators lack trust in teachers' technology identification and purchase decisions (Wachira & Keengwe, 2010, p. 23)
- Initially half-hearted about teaching with technology; "belief that using technology would not enhance learning" (Pierce & Ball, 2009, p. 302).
- Some mathematics teachers believe that students learn best by working with pen and paper; if they first use by-hand (pen and paper) skills for new procedures; technology will encourage boys but discourage girls (Pierce & Ball, 2009).
- Teachers' perception about students' attitudes toward the subject (Pierce & Ball, 2009), e.g., teachers are not convinced that technology use will increase students' interest, motivation, and confidence (Mumtaz, 2000; Pierce & Ball, 2009).
- "Teachers who prefer "teacher centered" model, the belief that technology use promotes a "student-centered" model may deter them from using technology" (Pierce & Ball, 2009).
- Teachers' belief that learning new technology will encroach too much on personal time, occurrence of unexpected technological problems will cause greater difficulty, higher use of technology will lower allocable time for completing course contents, and access to technology is too expensive for students (Pierce & Ball, 2009).

Students' attitudes

- Female students were less confident than males about using technology for learning mathematics (Pierce & Ball, 2009).

Parents' attitudes

- "If parents are opposed to the use of technology for teaching mathematics, then this may well be perceived by teachers as a barrier" (Pierce & Ball, 2009, p. 304)

Subjective norm refers to the subject teaching culture of the institute. Pierce & Ball (2009, p. 303) have asked, "do the colleagues they respect think that teaching with technology is a good idea? Does the school principal or mathematics coordinator expect them to use technology for teaching mathematics? What do the students' parents expect?" It is evident from the second question that subject culture is an attribute at the meso level. Although the subjective norm is a meso-level barrier, it has a strong affect on individuals' decision. If this barrier exists at institutional level then the barrier might resist change at individual level. Hew & Brush (2006) terms this as "subject culture," which is discussed in the next section.

5.2.2. *Meso (Institutional) Level Barriers*

Teachers' Subjective norm (social factors of organization)

- “Teachers generally teach the way they were taught” (Wachira & Keengwe, 2010, p. 24)
- Shaped by subject content, subject pedagogy, and subject assessment (Hew & Brush, 2006).
- Mathematics teachers believe that technology can hinder learning basics of the subject content and should not be allowed before mastery of concept or procedure; can only help doing calculations quicker and should only be used for verifying work on paper (Wachira & Keengwe, 2010, p. 22),

Leadership and Decision Support

- Lack of Institute-wide instructional vision; lack of support from institution leaders (e.g., principals) support (include permission, verbal statements, priority access, planning time, payment incentives, etc.) (Means, 2010, p. 299)
- Lack of teachers' involvement in decision-making to acquire technology for use in the classrooms; “lack of leadership led to the acquisition of a ‘mishmash’ of technology, tools”; “disparities in availability”; Lack of proper leadership and a lack of support from administration (Wachira & Keengwe, 2010, p. 22)
- Institutional support for the incorporation of technology into teaching practice is an important factor for some teachers.

Classroom Environment and Design

- Large class size, inconvenient tables and seating arrangement are barriers to computer use (Means, 2010, p. 302).

Collaboration as organization culture

- Lack of teacher collaboration or support from colleagues (Means, 2010, p. 299).
- Stakeholders (i.e., teachers, staff, parents, and students) are not involved in knowledge, skills and positive attitude creation (Afshari et al., 2009).

Organizational freedom at individual level

- Teachers need freedom to incorporate new ideas (An & Reigeluth, 2011)

5.2.3. *Macro (National) Level Barriers*

Teacher Training

- The pedagogical action “that educational technologists impose on preservice and inservice teachers does not appear to transform habitus,” which was formed fundamentally during infancy to early childhood and transformed to a lower degree during the K-12 education (Belland, 2009).
- Need to address teachers’ attitudes and perceptions of integration in subject (Pierce & Ball, 2009) (Belland, 2009); referred to as subject culture by Hew and Brush (2006).
- Professional development programs should stop telling and should show or demonstrate how to create technology-enhanced, learner-centered classrooms (An & Reigeluth, 2011).

National Politics

- Antagonistic attitude among political parties (Khan et al., 2012) and subsequent political unrests lead to changes in the policies and ICT-intervention projects that hinders the adoption.
- A political leader’s (Khan et al., 2012; Sharma, 2003) policy directions can either create hype for adoption or impede the change at the national level.

5.2.4. *Two-Tier barriers in macro- and meso- level*

Resources

The barriers associated with resources are mostly blamed at the institution (meso) level, yet they have great impact at the individual (micro) level. However, in general, literature mentioned that the resource barrier is also posed at the national (macro) level, which is, in most cases, responsible for the funding and facilitating resources (see funding barriers).

Table 3

Overview of sub-categories of the resource barriers

Sub-categories of Resources	Organizational Attributes
Availability of technology	<ul style="list-style-type: none"> • Training received and skills obtained from the macro level cannot be put in practice at the meso level for lack of technology resources (Wachira & Keengwe, 2010) • Lack of ICT resources include hardware (i.e., devices, peripherals) and software (Afshari, Bakar, Luan, Samah, & Fooi, 2009; Khan et al., 2012; Wachira & Keengwe, 2010) • Outdated hardware and software become useless (Khan et al., 2012; Tondeur et al., 2008) • High student/computer-ratio (Tondeur et al., 2008)

Access to available technology	<ul style="list-style-type: none"> Equity of access by teachers, students and administrative staff (Afshari et al., 2009) Lack of access to resources (Tondeur et al., 2008) Lack of access in appropriate locations (e.g., classrooms) (Wachira & Keengwe, 2010)
Time	<ul style="list-style-type: none"> Shortage of teachers, high teaching load, teachers are responsible for administrative tasks; require time for learning hardware and software, planning, collaborating, develop and integrate technology into curriculum (Khan et al., 2012, p. 72) Time pressures and competition with other school improvement initiatives reduce technology use during second year of implementation (Means, 2010) Busy with managing large class, preparing students for state tests , accountability of meeting curricular benchmarks (Wachira & Keengwe, 2010, p. 20)
Technical support	<ul style="list-style-type: none"> Lack of technical support on-site or in close vicinity, on-demand or scheduled, long queue or short, as planned or delayed lack of on-site and on-demand technical support; face-to-face informal vendor-support, help desk (Cuban, Kirkpatrick, & Peck, 2001; Means, 2010) Unavailability of institutes' internal ICT support (Tondeur et al., 2008) Lack proper maintenance (Khan et al., 2012) Long queue & delayed support (Wachira & Keengwe, 2010)
Resource Quality	<ul style="list-style-type: none"> Unreliable technology, "not functioning," "afraid it might fail in the middle of instruction" (Wachira & Keengwe, 2010, p. 20) Unpredictable malfunctioning or nonfunctioning of technology (i.e., unreliable) and lack of technical assistance lead to anxiety, degraded confidence, and fear among teachers: fear of making mistakes and feeling helpless; lack dynamic software that can support curricular goals (Wachira & Keengwe, 2010).
Funding	<ul style="list-style-type: none"> Lack of funding operates in both meso and macro level; and reflects at a meso level often to the need for more equipment or technology without sufficient funds to cover the needs (Alwani & Soomro, 2004; An & Reigeluth, 2011; Mumtaz, 2000). At the macro level it concerns insufficient state funds per institute (Wachira & Keengwe, 2010, p. 20) and no specific educational or it budget (Khan et al., 2012)
Lack of teacher or trainer	<ul style="list-style-type: none"> Lack of technically skilled teachers and trainers (Khalid & Nyvang, 2013)

Knowledge and skills

Most of the literatures identified and emphasized the need for improved knowledge and skills of teachers, who should be trained appropriately either by pre-service education and/or in-service workshops. For the professional development programs, the macro level of the education system recognizes the barrier and aims for standard-setting and proficiency-attaining. "Yet professional development time in particular is often not budgeted for.... one-off external in-service workshops tend to be of limited value in developing sustained transformation of practice" (Hennessy, Harrison, & Wamakote, 2010). In general, barriers related to knowledge and skills are rooted in the education system's (meso and macro) organizations, which are responsible for facilitating change. The ultimate solution is the professional development and training, which is provided

either by the institute or the national body. Thus, the following three sections summarize related barriers, based on the as categorized by Hew and Brush (2006).

1) *Specific technology*

- Teachers are new to technology uses and have no former personal experience; they lack skills and expertise, lack flexible time to learn, experiment, and plan for instruction use (Wachira & Keengwe, 2010).
- Low number of teachers attend in-service training (Tondeur et al., 2008).
- Lack of additional formal training (Means, 2010)
- Teacher training is more a one-time experience than iterative improvement (Khan et al., 2012).
- Stakeholders are not involved in knowledge, skills, and positive attitude creation (Afshari et al., 2009).
- Professional training lacks time for hands-on practice, are not subject-specific, insufficient about learner-centered instructions, mostly tell and do not demonstrate how to create technology-enhanced and learner-centered classrooms; locating high-quality models and exposing teachers to the models are difficult. (An & Reigeluth, 2011).

2) *Technology-supported pedagogical: replacement, amplification, & transformation*

- Teachers: “how to use tools to strengthen students’ understanding?” (Wachira & Keengwe, 2010, p. 23)
- Stakeholders are not involved in knowledge, skills, and positive attitude creation (Afshari et al., 2009).
- Teachers’ lack of *pedagogical* and *technological* knowledge in appropriation of technology (Tondeur et al., 2008; Wachira & Keengwe, 2010)
- Teachers lack content-specific training, ability to use technology to develop appropriate activities, training on appropriate technology use; generic technology training did not help learning content-specific ways of technology integration; School districts lack content-specific professional development (Wachira & Keengwe, 2010).
- Educational software team and teachers do not work together to support skills and subject teaching (Mumtaz, 2000).
- For motivation on integrating technology, colleagues’ and institutional support is essential (Pierce & Ball, 2009).

3) *Technology-related-classroom management*

- Teachers’ are not able to manage classroom technology; teachers do not want to be responsible for lost resource (Wachira & Keengwe, 2010).
- Change from teachers’ different habitual routines for organizing and orchestrating class activities (Means, 2010, p. 302)

Corruption

Corruption at the macro level leads to misuse and reduction of ICT budget, causing further effects on dependent factors in the educational system (Kessy, Kaemba, & Gachoka, 2006; Khan et al., 2012).

5.2.5. Macro-meso-micro three-tier barrier relationships

Assessment

Assessment is a macro-level policy that is enforced by the meso-level procedures and makes strong changes in the practices of micro level. Barriers associated with assessment are (a) pressure to meet higher standards, (b) score high on standardized tests, (c) cover vast scope of material within a limited amount of time, (d) consequences of promotion or graduation, and (e) external requirements of traditional examinations (Hew & Brush, 2006). Similarly, Wachira & Keengwe (2010) identified as barriers accountability of meeting curricular benchmarks and preparing students for state tests. So, these are macro-level requirements that are reinforced by educational institutes at the meso level. Caused by barriers in the assessment outcome policies and practices, even if sufficient skills are attained by the teachers, resources are available and access is ensured, the practice of teachers might significantly be resisted by long-term developed attitudes and beliefs (Ertmer et al., 2012).

Re-integration

Curriculum change at the macro level requires fundamental rethinking and re-integration at the meso and micro levels (Means, 2010).

Vision, strategy, and plan

Barriers at the macro level deal with inadequacy of plan for implementing ICT strategic policy, not providing schools with an understanding of educational rationales underpinning policy, and no explicit plan for changing the nature of teaching. Further, there is a “build it and they will come” model and lack of coherence and alignment within and across educational policies (Ward & Parr, 2011). The government’s vision lacks proper plan, policies, execution, and monitoring (Khan et al., 2012).

Subsequently, the meso level lacks ICT vision (Anderson & Dexter, 2000), lack of time to make the ICT strategy plan, lack of ICT policy plan, ICT integration plan, ICT integration leadership, integration support, evaluation of implementation of ICT integration, lack of technology policy with commitments to teachers and students, and inadequate scheduled time in computer labs for teachers and students (Tondeur et al., 2008; Wachira & Keengwe, 2010). In addition, institutions have inadequate plans for implementing ICT strategic policy (Ward & Parr, 2011).

Eventually, at the micro level, scheduling activities for integration and instruction is difficult. Integration of ICT depends on teachers' own grant application and their ability to get funded, which cause disparity in availability and students' exposure (Wachira & Keengwe, 2010).

6. Conclusion

This paper has reviewed the categorization approaches of the barriers to integrating and adopting educational technologies and argues for a holistic view of the barriers by drawing upon a macro-meso-micro theoretical framework. Almost all of the reviewed literature has been found to group the barriers as follows: by stakeholders' (teachers, administrators, students, parents) experiences, organizational scope (educational institutes and national educational organizations), external conditions or forces of a stakeholder or an organization, and commonalities and changes of these factors. These categorizations were emphasized in the existing literatures to facilitate coping with the barriers. The overarching intention of this paper was to look at the holistic nature of the barriers originating from the education system and its container environment, which situate the barriers' contexts. Thus, the paper based on the three-tier education system contained within a national context, that is, micro (individual), meso (institution), and macro (national and regional) levels. In addition, the education system is contained by the national context, which involves some barriers that are not within the direct authority or scope of the education system's stakeholders.

The paper draws strong attention to the barriers posed by the national environment of the education system. There is a need for facilitation from the national (macro) entities for longer term hands-on training, resource allocation, greater funding, objective of student-centered learning as opposed to state test score, and development of trainers. Institutional (meso) level should have IT policy, plan and procedure for sustainable change, leadership for integration, separate IT budget for operations and maintenance, and prompt technological and pedagogical support. Individual (micro) level barriers are either the recurrent experiences of the macro or meso level barriers or the perceptions developed from the practices within the learning environments, across formal, non-formal and informal spaces.

It is evident that the macro level's pre-set goals conflict with expectations from the meso level's educational technology integration because the macro level's pre-set requirements of covering a greater amount of content and targeting high achievements in state test do not allow time for teachers to achieve desired change. High teacher-student ratio and high technology resource versus user ratio are still prevalent. Student-centered customized facilitation is expected from teachers, but teacher-focused customized training and support facilitations are not available. Furthermore, the change facilitation cannot use the "one size fits all" approach; research and development should be situated and more context sensitive (Beland, 2009). Instead of "system blame" or "individual blame", an integration and adoption approach should consider national holistic view with careful policy, procedure, and practice changes. The barriers are associated with the

innovation (ICT in education) adoption by “individuals” (stakeholders in education system) and “organizations” (macro and meso level entities) (E. M. Rogers, 1995).

Following Gallivan’s (2001) directions, this paper suggests that change agents should facilitate innovation adoption of both the individual level attributes and organizational level attributes, which are experienced as barriers. It is rather difficult to consider a barrier as a single-tier problem; rather it involves multiple levels of the education system or external force to address it. Further research should use appropriate methods for illustrating dependencies among the barriers of situated contexts. The complexities involved in the relationships of the barriers and their complex dependencies will enable further understanding of the perceptions of the stakeholders and thereby facilitate addressing the root causes.

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Paper III

Application of PLA Methods in Educational Technology Research: A Rural Bangladeshi Case

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Abstract

This chapter examines barriers and methods to identify barriers to educational technology in a rural technical vocational education and training institute in Bangladesh. It also examines how the application of participatory learning and action methods can provide information for barrier research and stakeholders in and around the school to pave the way for change by building awareness of both educational technology and the complexity of barriers. In this case study, school stakeholders are involved in the research and awareness-building process through three different data-production methods: cultural transect, problem-tree analysis and focus-group discussion. The paper concludes by categorizing the barriers identified at different levels: micro (roughly the individual level at which the lack of knowledge and motivation are significant barriers), meso (roughly the school level at which the lack of teachers and computers are significant barriers) and macro (roughly the national level at which the lack of government planning and the lack of training of teachers are significant barriers). Finally, the paper also concludes that applied participatory learning and action-oriented techniques showed potential to provide researchers and local practitioners with situated insights that could not just have been lifted out of existing research literature.

Preamble

The integration of information and communication technology (ICT) in education and the adoption of educational technology have been subject to research for at least thirty years (Lowther, Inan, Strahl, & Ross, 2008). A simple search on this issue returned 80,500 articles from the Educational Resources Information Center (ERIC) database. A large part of this literature, in the context of educational institutes, has explored the barriers, grouped them into categories, identified relationships and suggested approaches to eliminate or circumvent barriers (see for example, Balanskat, Blamire, & Kefala, 2006; Chan, 2011; Ertmer, 2005; Ertmer et al, 2012; Hew & Brush, 2006; Pelgrum, 2001). However, previous literature lacks advice on methodological approaches to explore barriers of a situated context and lacks a theoretical foundation for categorization. Thus, the current chapter addresses these issues through three interre-

lated questions. Firstly, which methodological approach and which methods would enable participants to extract and present the interdependent barriers in a specific context? Secondly, in a situated case, how are these barriers related? Thirdly, do the barriers in the situated case indicate any pattern for theoretical contribution?

Methodologically, the current chapter takes its point of departure in Hew and Brush's (2006) findings, arguments and directions for further research on educational technology integration and adoption barriers. They analyzed 48 empirical studies from 1995 to 2006 and found that previous literature appeared to have one or more of the following four main limitations: (a) incomplete description of methodology (i.e., research duration, number of participants involved and interobserver and intraobserver reliability), (b) sole reliance on participants' self-reported data (i.e., interviews or surveys), (c) short-term in duration (i.e., five days to less than two years), (d) primary focus on the teacher and what went on in the classroom (i.e., not on the decisions and policies at school and district/national level). They suggested that future technology integration research should be based on the principles of mixed methods. This is defined as "the class of research techniques, methods, approaches, concepts or language in a single study" (Johnson & Onwuegbuzie, 2004, p. 17). Mixed-methods research frequently results in superior research because of its key-defining feature — methodological pluralism (Johnson & Onwuegbuzie, 2004, p. 17). Hew and Brush (2006) specified that future mixed-methods-based educational technology research should underpin the following principles: (a) thorough description of methodology (including length of the study, number of participants, interobserver and intraobserver agreement reliability), (b) observation of actual practice and no reporting of self-reported data, (c) longitudinal research, (d) examination of other decision-making stakeholders (i.e., school administrators, leadership, decision-makers in a broader context). Current literature attempts to overcome the identified methodological limitations through the application of participatory learning and action (PLA) methods, previously known as participatory rural appraisal (PRA) (Robert Chambers, 1994a, 1994b; Narayanasamy, 2009). With a strong foundation in methodological pluralism principles, PRA and PLA have a long history in the development research fields of agriculture, health, and education (Robert Chambers, 2008; Narayanasamy, 2009) (Robert Chambers, 2007; Narayanasamy, 2009), but to the knowledge of the authors, PLA has not been applied in the context of educational technology.

For situating the case, Bangladesh was purposefully selected, as Khan (Khan, Hasan, & Clement, 2012) reviewed the barriers in a Bangladeshi context and stated in his concluding statement:

"as ICT is a relatively new field in Bangladeshi education systems, more in-depth research should be conducted related to the integration of ICT into classroom situations".

Thus, considering the situated-single-case qualitative research in Bangladesh for the integration and adoption of ICT in education, a second tier research question is: how do the stakeholders of rural Bangladeshi educational insti-

tutes experience educational technology integration and adoption barriers?

This chapter is organized into four sections. The first section deals with the application context of PLA. In the next section, the context-appropriated methodology and selected methods of PLA will be elaborated. In section three, the initial phase of case experience, data collection, and analysis will be reported, and in the fourth section, based on the evident pattern of relationships, the barriers will be categorized and mapped in a macro-meso-micro model of the education system.

The Context of the Case Study ICT in Education and TVET Education in Bangladesh

In the developing countries of the Asia Pacific region, there is an increasing emphasis on ICT in education (Akhtar & Arinto, 2009). Notably, the “Vision 2021: Digital Bangladesh” declared that improving the education sector through the use of ICT in education is a strategic priority of the nation (A2I: PMO, 2009; BOI: PMO, 2009). The country’s Access to Information (A2I) project hosted by the Prime Minister’s Office (PMO) plays the central role in all the public initiatives related to this vision. The current research project was inspired by an A2I presentation titled “Strategic Priorities of Digital Bangladesh: Improving Education Sector”, which mentioned six focus areas for improving teaching and learning through the use of ICT: general and TVET education systems, ICT literacy for students, professional development of teachers using ICT, education-related citizen services, ICT in education administration, ICT infrastructure and delivery channels (A2I: PMO, 2009). The presentation also put explicit “focus on subject-based use of ICTs rather than ONLY ICT literacy” (A2I: PMO, 2009), which referred to educational technology integration and adoption. Moreover, it called for special emphasis on TVET (A2I: PMO, 2009). It envisioned “ICT literacy as a market-driven trade in TVET” (A2I: PMO, 2009). In addition, the education and research objectives of the Bangladeshi government’s national ICT Policy-2009 (MoICT, 2009) and its strategic themes and action plans guided the scope of current research. Furthermore, the country’s strategic approach to develop a knowledge economy is commensurate with the scientific course: “ICT in education as a resource for better teaching and learning and as a preparation of citizens for the Knowledge Society” (Khakhar et al, 2007).

Bangladesh has three different parallel education systems, i.e., General, Madrasa (Islamic) and TVET. Among these, to get accredited by the education board, only TVET institutes are required to have at least one computer lab and a computer teacher. Until 2011, at the K-12 education levels, only the TVET curriculum had a compulsory computer course from the ninth grade and above. In addition, for the populous rural area of Bangladesh, TVET is a prospective system for human resource development, poverty alleviation, rural development and education for all achievement (Basu & Majumdar, 2009). Emphasizing these areas, the European Commission (EC) provided financial support for the “TVET reform project” (Mia, 2009) and researchers identified TVET curriculum reform requirements (Ahmed, 2010). Moreover, the period 2005-2014 is the United Nations Decade of Education for Sustainable Development, and

TVET has been nominated as one of the key areas for a collective UNESCO effort (Hollander & Mar, 2009). Thus, the current research case was propelled by the international and national agenda for TVET and ICT in education.

Significance of Rural and Private Institutes in Bangladesh

Most of the populations of developing countries and their educational institutes are rural disadvantaged and therefore require great attention. Almost 70% of the world's poor live in rural areas (World Bank, 2012). Similarly, Bangladesh has a population of about 142 million (BBS, 2011) and 72% of the citizens live in rural areas (World Bank, 2012). At the secondary level of General education (i.e., junior secondary school, secondary school and school and college), 80% of the institutes/schools (i.e., 15285 out of 19083) are located in rural areas (BANBEIS, 2010). Among these schools, more than 98% (18766 out of 19083) are private schools, and among the private schools more than 81% (15257 out of 18766) are located in rural areas (BANBEIS, 2010). On the contrary, less than 9% (28 of 317) of the public schools are located in rural areas. In the TVET sector, more than 91% of the institutes/schools (2597 out of 2848) are private schools (BANBEIS, 2011). Moreover, schools in developing countries lack school facilities, which affect academic achievements (Okoza, Aluede, & Akpaida, 2012; Sabitu, Babatunde, & Oluwole, 2012; Vandiver, 2011). In addition, ICT in TVET necessitates more school facilities, which is a great challenge for the low-capital private school founders and in the rural context. Thus, educational development initiatives in Bangladesh could very well be centred in rural areas and focused on private institutes/schools.

Methodology

Transformative researchers "believe that inquiry needs to be intertwined with politics and a political agenda" (Creswell, 2003, p. 9) and should include an action plan for change "that may change the lives of the participants, the institutions in which individuals work or live, and the researcher's life" (Creswell, 2003, pp. 9–10). This paradigm argues for participatory methodology and mixed-method approaches for the development of "more complete and full portraits of our social world through the use of multiple perspectives and lenses" (Somekh & Lewin, 2005, p. 275) to gain an understanding of "greater diversity of values, stances and positions" (Somekh & Lewin, 2005, p. 275). The transformative paradigm does not generally begin with a theory but "generate or inductively develop a theory or pattern of meanings" (Creswell, 2003, p. 9) during the research process. However, unlike other paradigms, transformative research emphasizes social justice and marginalized people (Creswell, 2003, p. 9). So guided by the transformative paradigm, the current research project brings voices from the rural marginalized people and looks for patterns of barriers in the integration of educational technology.

This section presents the case and methods as recommended by Hew and Brush (2006), which was discussed in the 'preamble' section.

The Case: Rural Bangladeshi Private TVET Institute

This chapter's first author was this research project's change agent (CA) (Rogers, 1995) in the field. The current chapter uses the acronym and the term to indicate the first author.

A typical private rural TVET institute in Bangladesh, named Tofail Ali Technical School and College (TTSC), was purposefully selected. The CA had acquaintances with the TTSC founding members and had been facilitating ICT adoption at the institute during the period mid-2009 to mid-2010, i.e., before the current project was initiated. Thus, within the duration of the current research project, TTSC was the only institute in a rural context that would allow sufficient mixed-method-based understanding gained for a period of two years or more. The intention was to overcome the limitation "short-term in duration (i.e., five days to less than two years)" (Hew & Brush, 2006) of qualitative studies on educational technology. Therefore, in December 2010, as part of the current project, TTSC administrative authorities approved continued research by the CA and approved to take on the role of consultant to enable change at the institute. The CA conducted two field studies within the current project: from August 2011 to January 2012 and from August 20, 2012 to September 29, 2012. The CA played the role of a CA for the diffusion of ICT in the learning activities in formal (both curricular and extra-curricular activities), non-formal and informal contexts. In addition, the CA facilitated the adoption of ICT in the academic administration and the overcoming of overall ICT adoption barriers. This chapter is based on the mixed-method application experience conducted during the first field study.

The authors arranged a sponsorship of USD 3000 for the TTSC (CLP, 2010) and partnered with an NGO-initiated three-year public-private-partnership pilot program called "Computer Literacy Program" (CLP, 2012). In 2010, the program called for a sponsorship to pay part of the cost for establishing one smart classroom (SCR) and one computer literacy center (CLC) at the sponsored school (CLP, 2011a, 2011b). The project partners include: an NGO named Development Research Network (D.Net), a Volunteers Association for Bangladesh, New Jersey, USA (VAB-NJ) and the Bangladesh Computer Council (BCC) under the Ministry of Information and Communication Technology, Bangladesh. At the TTSC, the SCR was established in June 2011. The CLP provided one laptop, one 32-inch LCD TV, 200-watt hybrid solar system, one audio cable, one VGA cable, a one-year maintenance contract and four trained teachers (CLP, 2011a). The CLC was established in June 2011, equipped with four laptops, one laser printer, one EDGE modem, one flash drive and two trained teachers. The initial goal of the SCR was to bring change to teaching and learning activities in relation to English, mathematics, science and geography for 6th to 10th grade students. The goal of the CLC was to provide computer literacy to an 8-student batch per month, giving BDT 500 (corresponding to USD 6.15) as incentive to a teacher for the additional effort of 40 hours and a BDT 200 as incentive to a student assistant (corresponding to USD 2.46) for the same duration. The pilot project provided no further explicit information about the operations and maintenance costs and services, integration or adoption strategies.

The TTSC had been imparting education to IX-XII/9th to 12th grade students

since its inception in 2000. The Bangladesh Technical Education Board (BTEB) approved the TTSC for teaching seven trade disciplines in Secondary School Certificate vocational (SSC voc), two trade disciplines in Higher Secondary Certificate in Business Management (HSC BM) and seven short-duration vocational certificate courses. In addition, the TTSC Junior School (TTSC-JS 6th-8th grade) and the Tofail Ali Kindergarten (TTKG; pre-school to primary) were established later on to ensure quality and quantity of students for the TTSC. These three institutes situated in close vicinity of each other were founded by the same person. The TTKG and the TTSC-JS were founded to become feeder institutes/schools to the TTSC, because, if a neighbouring school's students want to be admitted to the TTSC, the host institute does not approve the transfer. Despite being two separate institutes operationally, the TTSC and the TTSC-JS (combined 322 students in December 2011) had been sharing teaching loads and institutional resources. During December 2011, the TTSC's SSC VOC/voc had 16 (out of 23) vacant teaching and staff positions and the HSC BM's vacancy count was 3 (out of 11) positions. The founder is a retired public official who used to work in many administrative and academic positions in the Bangladeshi TVET system. The chairman of the school board is a high-ranking administrative officer of the Bangladeshi government. The top-tier administrative positions include the founder, chairman and the principal.

Methods – Participatory Rural Appraisal (PRA)

PRA, also termed participatory learning and action (PLA) (Chambers, 1994), is established and defined as an umbrella of methods, techniques and principles. The current research project applies this mixed-method approach in a single-case educational technology research study. The CA began the first field study with this question — which PRA/PLA methods are suitable for participatory collection and analysis of barriers to educational technology integration and adoption?

The PRA methods have been adapted and contributed through this research project in some ways: application in a new intervention discipline (i.e., ICT in education), the participants (i.e., stakeholders in education) and the facility locations (i.e., schools or academic institutions). The research project experienced academic institution-centered PRA method adaption. Through these methods, data were collected from students and teachers in the form of text and narratives. The CA and some teachers facilitated large groups of participants. This PRA application also used academic institution members as a hub of community, who analyzed the rural context. Identifying the most suitable method was very much situation dependent, experience guided and participant supported. For instance, the CA wanted to gain a quick overview of the situation at the beginning of the field work and applied his own experience of using PRA in other contexts. Thus, the problem-tree analysis was selected as the central method, while other methods were used for 'triangulation' – to verify and validate. The methods used will be discussed in the following.

Problem-tree analysis (PTA) is one of the flow diagramming techniques (Narayanasamy, 2009). Practically, a flow diagram makes it possible to assess the causes and effects of a defined problem or issue, determine the baseline and

impact of development interventions and to study the flow of resources. In particular, the problem tree or the problem-tree analysis discovers the negative aspects of a situation and represents 'cause-and-effect' relationships between the problems that exist. The procedure preceded a focus-group discussion which identified and defined a problem. In view of the problem, the exercise will result in a visual presentation in the form of a 'problem tree' or 'directed graph' to establish 'cause-and-effect' relationships. The two following alternatives are at hand: Firstly, Gubbels & Koss (Gubbels & Koss, 2000) demonstrated a simple 'problem tree' presentation with a hierarchy of causes and effects. Secondly, Narayanasamy (Narayanasamy, 2009) showed a problem tree in the form of a 'directed graph', which he termed 'hierarchy of problems'. During this research project, both presentations were exercised/applied. Each group iterated the exercise twice. In the first exercise, the 'problem tree' was used, and in a second exercise, the 'directed graph' was diagrammed.

The focus-group discussion (FGD) method was found the most effective one by the participants from academic institutes. It identified the problem to be addressed with facilitation from the CA. This action research applied FGD as a two-way communication between the CA and the participants. As David L. Morgan (Morgan, Krueger, & King, 1998) mentions, a three-part process of communication is seen in an FGD: (i) the research-team member decides what he needs to hear from the participants; (ii) the focus groups create a conversation among the participants about these chosen topics; and (iii) members of the research team summarize what they have learned from the participants. Furthermore, to facilitate the group discussion, Chamber's (1992) recommendations were followed — "relaxing not rushing, showing respect, 'handing over the stick' and being self-critically aware". Thus, FGD was used as a vehicle for a two-way 'diffusion communication' (Rogers, 1995). The probable roles of the 'change agent' (Rogers, 1995) in relation to ICT integration and adoption were also discussed. Consequently, the participants were facilitated to define a problem which can be addressed with support from the CA.

Semi-structured interviews (SSI) were conducted to clarify and further analyze the cause-and-effect relationships of the problem-tree analysis, because some of the terms were context sensitive and more analyses from the local analysts (students and teachers) were required. Theoretically, in PRA, the SSI technique is used extensively as a "guided interview where only primary questions are predetermined" (Narayanasamy, 2009). During these research interviews, the participant groups' problem trees were used as a flexible 'checklist or guide' (Mikkelsen, 2005). Five teachers and seven students voluntarily participated in SSIs, which in the case of students turned out to be FGDs of three and four members. During the SSIs, barrier relationships were verified individually and in groups, and each relationship was validated by means of specific examples.

Cultural transect enabled the researcher(s) "to traverse through the 'life' of a person, a subsect of the village, or the village itself over a period of time (it may be a day, or a week, or more)" (Mascarenhas, 1992). The CA attached himself to a lecturer and the principal, grouped with sports-enthusiast students, lived with a family and actively engaged in ICT integration and adoption activities, observed others' experiences and discussed how to discover patterns of the

academic life of students and teachers in rural settings — why they are what they are. Thus, cultural transect includes all the live-in-field experiences of being part of a rural family during the entire stay, being associated with three academic institutes, students, parents, teachers, often providing the administrative support, teaching, fund raising, facilitating official meetings, conducting in-house training, student counseling, winter cloth distribution for charity, etc., - all inseparable parts of being ‘a member of the institute’. In other words, the daily logs, notes, images, videos, face-to-face interactions and activities and unplanned observations constitute the cultural transect data.

Participant observation and non-participant observation were conducted during the study. By definition, participant observation is a method according to which the observer is a part of the phenomenon or group which is being observed and he/she acts both as an observer and as a participant (Robert Chambers, 1994b). In case of ‘non-participant observation’, the observer does not participate in the phenomenon being observed. In this research project, both methods were applied as part of the cultural transect. A checklist including the causes and the effects identified in the problem-tree analyses was the basis when looking for evidence. The CA kept notes of the events, incidents, conversations and discussions related to the qualitative insights gained about the checklist or additional issues that were not discussed in the PTA.

Combinations and Sequences of Methods

This section shows an at-a-glance presentation of the application sequence of the PRA methods, because one of the greatest strengths of these methods is their combinations and sequences (Shah, Bharadwaj, & Ambastha, 1991) (Robert Chambers, 1994b). Through this methodical non-linear sequence, the intention was to facilitate the participants to select a problem, identify the causes, analyze the cause-and-effect relationships and identify the issues which could be handled with immediate facilitation. The selection and application process of this method was situation experienced rather than based on pre-knowledge planning. Thus, the four stages in Table 1 attempt to summarize the application of PRA with the purpose to answer: Firstly, which methodological approach and which methods would enable participants to extract and present the inter-dependent barriers? Secondly, in a situated case, how are these barriers related?

Table 1. Stage-Outcome-Method-Participants
Sequence of PRA for Problem Formulation

Stage	Method(s)	Outcome	Participants
Commonly agreed problem selection and definition	2 FGDs	Problem statement	19 12 th graders 7 teachers
Cause-and-effect relationships with the problem	2 problem-tree analyses	Cause-and-effect analysis	19 12 th graders 7 teachers

Stage	Method(s)	Outcome	Participants
Context-dependent clarifications about cause and effects	FGDs and SSIs	Explicit examples to represent causes and effects, context appropriation for translating local terms	5 12 th graders 5 teachers
Causes – why do these barriers exist? Who causes barriers in which way? Do relationships and/or patterns appear evident?	Cultural transect	Outsiders become ‘participant observer’: change agent live-in-field experiences from daily practices and events	Change agent, students, teachers, admin roles, parents

Triangulation — The Validation Process

Triangulation (Grandstaff, Grandstaff, & Lovelace, 1987) is an essential PRA principle. It is a validation process of progressively learning, cross checking and approximating through progressive plural investigation. The process involves various ways of “assessing and comparing findings from several methods - often three: type of item or set of conditions, points in a range or distribution, individuals or groups of analysts, places, times, disciplines, investigators or inquirers and combinations of these” (Robert Chambers, 1994b). There are many types of triangulation; Mikkelsen (2005) suggested five types and their sub-types: data triangulation, investigator triangulation, discipline triangulation, theoretical triangulation and methodological triangulation. Furthermore, data triangulation is further divided into three types: personal triangulation, space triangulation and time triangulation. Within the third-level categorization, personal triangulation is defined as the process of considering the reactions at three levels of analysis: (i) individual, (ii) groups and (iii) collective. Regarding methodological triangulation, two types exist: the within-method and the between-method. If the same method is used for different topics, it is called within-method triangulation. Between-method triangulation includes a blend of two or more different methods in the analysis of the same topic.

The current research project conducted data triangulation at each of the three personal triangulation levels in the form of SSIs with individuals, groups’ FGDs and problem-tree analyses, and collective cross-checking and summarization using cultural transect experience of the change agent. Therefore, the current research project involved data triangulation of the personal triangulation type conducted at the same space or in the same situation and during the same time interval, i.e., FGDs, problem-tree analyses and two SSIs were conducted on the current topic, during three afternoons within a period of nine days in September 2011. In addition, this research project applied between-method triangu-

lation by applying all the methods on a single topic. Therefore, validity was addressed in a two-fold triangulation 'process: by means of three sources and three methods (see Figure 1.).

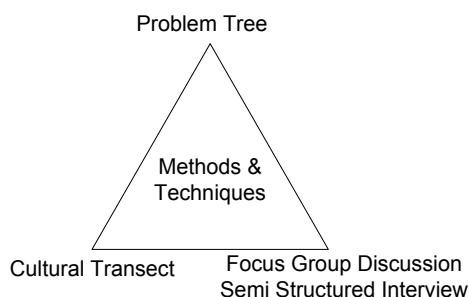


Fig 1a. Between-method triangulation

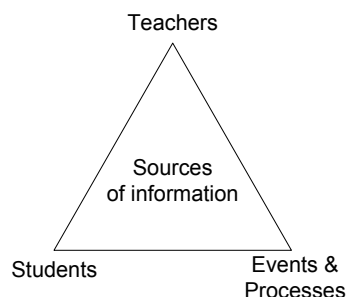


Fig 1b. Personal triangulation

The application of these methods preceded a 'rapport building' (Robert Chambers, 1994b) phase of about seven days. During a period of approx. six months, fieldwork in Bangladesh, FGD, PTA, and SSI were applied within the first two weeks of an overall four-month stay in the village. However, validation by cultural transect may have been covered by some insights gained from second-field studies and subsequent communication over the telecom and internet media.

Facilitation of PRA Methods

In the current research project, it was mainly the 12th grade students and the teachers of the TTSC who participated in the PRA methods (i.e., FGD, PTA, and SSI). In addition, daily interactions and conversations with the students from ninth, tenth and eleventh grade significantly contributed to the validation through cultural transect experiences. The facilitator role was conducted by the CA and he was often assisted by one lecturer of the TTSC. The lecturer is very popular with the students of the institutes and was recommended by teachers to take on the role of facilitator. In some cases, the principal is in charge of the facilitator role, thus providing an increased opportunity for the participants to be heard by an administrative person. Hence, an institution-based PRA application might be easier compared to other contexts in which an agreed-upon popular leadership or positively-accepted administrator is not at hand during the facilitation process.

Two workshops were conducted for the problem-tree analyses, each of which began and ended with a focus group discussion. Each workshop took about three hours during two afternoons. In the first workshop, the participants comprised 19 12th grade students who split into three groups. In the second workshop, seven teachers participated. Their designations were principal, lecturer (accounting), lecturer (management), computer demonstrator, trade instructor (general electrical works), assistant teacher (language) and assistant teacher (mathematics). During the two workshops, one group of teachers and three groups of students created four problem trees. Similarly, immediately after the

exercise, each group conducted a rigorous analysis while creating a dependency relationship of causes and effects. Both groups' workshops ended with a focus group discussion of approx. half and hour on how to solve the problem. In particular, the discussion took a turn towards identifying who would be responsible for the desired change and for addressing barriers to the change.

The field activities were recorded in the form of plans, actual activities, problems faced, discussions, analyses, decisions and various incidents. These were recorded on paper, smart-phone, and computer – in the form of text, images, audio and video recordings. The participants' workshop activities were conducted on large sheets of papers using multi-color pens, sign pens and pencils.

Dealing with Local Dialect and Translation

All the methods were conducted in Bengali, the native language of the participants and the CA. Furthermore, since most of the participants used to speak the local dialect of Brahmanbaria, the facilitators (particularly the CA) tried to use the local accent. This attempt often eased the communication and enabled stronger rapport building.

Strong emphasis was put on the translation process to ensure context-appropriate translation. Firstly, the CA together with the English language teacher of the TTSC translated the problem-tree diagrams from Bengali into English. The teacher is a permanent resident of a neighboring village, which made it possible to deal with the contextual meanings. Thus, the translation exercise contributed in the form of a semi-structured interview. Secondly, the translations were verified with/by an urban-school English language teacher, who had affinity with rural education. Thirdly, the translations were verified with/by a Bangladeshi researcher.

The PRA Application Experience and Data Analyses

Setting the Scene – How the Application Process Began

The PRA implementation process began with the village mapping method. This method resulted in geographical, demographical and additional information about the study village, which is the host/hometown of most students and teachers. Approx. all the 12th graders and four alumni of the TTSC participated in the village mapping workshops. During the last workshop, in the presence of two lecturers, the principal initiated an unstructured group discussion regarding “educational ICT skills and adoption - what can be done next to take advantage of our brother [CA]?” After minutes of motivational words from both the teachers and the CA, the students began to respond. The participants decided on one common issue: “we have not acquired enough/any idea on how or why to use computer and Internet for a real-life purpose although we have and had compulsory computer subject(s)”. The teachers supported the students' grievances by saying,

“we never had such a skilled teacher, we always lack a computer teacher, we are not subject experts, and we have too many problems.....we feel that there is a need....but we cannot say what that is”.

Eventually, the facilitation to form a problem statement looked like this:

“students are not acquiring computer and Internet-related vocational and practical skills from the institute”.

Driven by the jointly identified problem and previous PRA application experience, the CA felt that it might be appropriate to use the problem-tree method. The CA tested it with a few students and a teacher before deciding to do so.

Data Analyses and Discussions

These analyses include the participants’ analyses and the researchers’ analyses of the problem statement: “students are not acquiring computer and Internet-related vocational and practical skills from the institute”. Through the PTA method, the participants identified the barriers (as causes), the relationship within the barriers, the effect of the barriers (as effects) and the relationships of the effects. The CA merged the four tree diagrams into one — for gaining further insights from the relationship of the barriers. While the first phase of the PTA was based on the participants’ analyses, the merging process involved the CA’s analyses. With this backdrop, the process of merging the PTAs and the process of validation using FGD, SSI and cultural transect will be discussed in this section.

During the field study, the first four problem-tree analyses were central to exploring the problem landscape. The causes and effects of the PTA have been summarized in the following two tables. Table 1 and 2 show the causes and effects, respectively. Against each cause or effect, each group is represented by a letter: the teachers’ group by a T, the students’ group one by an A, group two by a B and group three by a C. The student workshop identified and analyzed 25 causes and the teacher workshop discussed their 32 causes. The three student groups A, B, and C contributed 18, 14 and 13 causes, respectively. Table 1 shows the accumulated 43 causes analyzed by both teachers and students. Among these, 18 causes were only mentioned by teachers, 11 causes were only mentioned by students, and 14 causes were mentioned by both teachers and students. The participants confirmed that the 14 causes mentioned by both groups are the most frequently discussed issues and these might be the urgent ones. In addition, the participants discussed/agreed that these barriers cannot be addressed one at a time; each cause is related to several other causes. Furthermore, the teachers explained that the acquisition and maintenance of technology resources involve many issues that are related to the institution’s initiatives, rural infrastructure and cultural attitudes.

Table 1. Summary of Causes of the Problem

Causes	Groups			
Long delayed acquisition and repair of equipments	T	-	-	-
Low teacher quality	T	-	-	-
Lack of teacher training	T	-	-	-

Causes	Groups			
Negative attitudes of surrounding social environment	T	A	B	-
Insufficient number of computers	T	A	B	C
Lack of computer accessories (printer, memory card, Internet Modem, Card Reader)	T	A	B	C
Unreliable network (both mobile and Internet)	T	-	B	-
Lack of technical support for maintenance (caused by, 1) the lack of facility in close vicinity, 2) the lack of facility at the school)	T	-	-	-
Lack of parents' awareness	T	-	-	-
Lack of (vocational trade) teachers due to the government's teacher registration examination	T	-	B	-
Students' irregular attendance	T	-	-	-
Infrastructure problems	T	-	-	-
Unreliable electricity	T	A	B	C
Higher student population than available resources	T	-	-	-
Lack of well-groomed students as former educational attainment quality is lower than essential	T	-	-	-
Insufficient number of laboratories	T	A	B	C
Low teacher retention (troubles students and reduces attendance rate)	T	-	-	-
Troublesome commuting system and facility	T	A	B	C
Lack of (technically) skilled teachers	T	A	-	C
Due to financial insolvency, teachers lack concentration in delivering lessons	T	-	-	-
Students' weakness in English	T	A	B	C
Insufficient classrooms	T	A	-	C
Unavailability of (computer) teachers despite repeated employment notices in the newspapers	T	-	-	-
Lack of computers in working condition	T	-	-	-
Directorate of Technical Education (DTE) and Bangladesh Technical Education Board (BTEB) lack sufficient manpower for proper administration	T	-	-	-
Cannot give appropriate honorarium to part-time teachers	T	-	-	-
Institute's financial insolvency	T	A		C

Causes	Groups			
Lack of government's planning and patronizing	T	-	-	-
Financial insolvency of a students' family	T	-	-	-
Teachers lack application skills (despite passing from polytechnic institute)	T	-	-	-
Lack of facilities for industrial attachment	T	A	-	-
Lack of directions from teachers	-	A	-	-
Lack of general knowledge	-	A	-	-
Lack of library to try (new) applications	-	A	-	C
Lab classes are not held regularly	-	A	-	-
Lab class exercises lack computer use appropriation for practical needs	-	A	-	-
Local managing committee lacks sapient members	-	A	-	-
Lack of teachers	T	A	-	C
Lack of books on computer and Internet applications	-	-	B	C
Students lack motivation	-	-	B	C
No scope of access outside school	-	-	B	-
Family cannot afford computer, etc.	-	-	B	-
(Students and Teachers) fear of computer usage/causing malfunction	-	-	B	-
Number of effects mentioned in each problem tree	32	18	14	13

Stating causes was much easier than reflecting on the effects, and the active participation of the CA was facilitating. Both the teachers and the students had difficulties in visualizing the benefits of the skills. The significance of the challenge may be realized by a teacher's reflection, who is a graduate from a polytechnic institute. The teacher stated, "last year I had accumulated savings of 70,000 taka with a plan to buy a computer and an Internet connection. I could not finally decide on buying those. I could not see much benefit because I did not have the required knowledge, confidence and skills. But, now that you [CA] are here, I shall buy soon and learn from you". The participants confirmed that the discussions and activities with the CA, the feeling of living together in the same environment and the active participation in the activities had enabled them to realize the effect. Otherwise, reflecting on the effects might have been much harder. As part of the effects analyses, the teachers discussed their nine effects and students discussed their 19 accumulated factors identified by the three groups. Student groups A, B and C wrote twelve, six and seven effects, respectively. Table 2 shows the merged list of 27 effects. Among these, seven effects were mentioned by the teacher group only, and 18 effects were mentioned

by the students only. The participants expressed that these effects could only be realized through the activities and discussion with the CA. On behalf of the group, one teacher summarized that

“if we can learn to apply these technologies, we shall benefit from getting access to the new public services on the Internet, we can look for better job opportunities, and it will benefit our teaching and learning activities”

Thus, it is evident from this statement that the current barriers could hinder the desired change in ICT for education, livelihood and public services.

Table 2. Summary of Effects of the Problem

Effects	Groups			
Cannot sustain in the competitive technology job market	T	-	-	-
Cannot apply TVET education in job	T	-	-	-
Cannot communicate for higher education	T	-	B	C
Limiting scope of pursuing higher education through the computer	T	-	-	-
Not being able to use for practical needs of life (educational and other information and news)	T	-	B	-
The goals of TVET are not being achieved	T	-	-	-
Increasing rate of unemployment	T	-	-	-
Job opportunities exist but the unskilled cannot be employed	T	-	-	-
Ending with general education despite studying in technical educational institute, resulting in losing interest in technical education	T	-	-	-
Cannot/shall not get a suitable job	-	-	-	C
Cannot create self employment	-	A	B	-
Cannot print various documents	-	A	-	-
(Due to a lack of English proficiency) cannot communicate with non-Bangla speakers	-	A	-	C
Cannot access online results	-	A	-	-
(Without Internet) necessary travel and communication for possible online activities increase cost	-	A	-	-
(Without Internet) cannot access (all public services and academic) forms	-	A	-	-
Collecting entertaining media from distant market(s) or place(s) costs more time	-	A	-	-

Effects	Groups			
(Without Internet) academic communication takes more time	-	A	-	-
Cannot search for jobs (online)	-	A	-	-
Cannot communicate (online) with relatives staying abroad	-	A	-	-
Cannot read online newspapers	-	A	B	-
(I or family) cannot decide on the purchase of a computer and Internet access	-	A	-	C
Cannot share (spread) technology knowledge among others	-	-	-	C
Not getting a good job due to weakness in computer skills and English	-	-	-	C
Cannot access various news and general knowledge about the world	-	-	-	C
Cannot play computer games for entertainment	-	-	B	C
Cannot access educational information available online	-	-	B	
Number of effects mentioned in each problem tree	9	12	6	7

All causes and effects were validated by all the participants and noted by the CA through the events. Focus was only on the causes (i.e., barriers), which were the focus of this study. The validation process involved FGDs, SSIs and cultural transect (i.e., observed evidence and group reflections). In this process, FGDs after the PTAs validated the causes and the effects. In addition, a high degree of the validation was completed in the students' PTA discussion. The after-PTA exercise, i.e., the FGD with teachers, involved the validation of the students' PTAs. Subsequently, the CA looked for specific evidence through SSIs and cultural transect to further understand the context and thus contribute to the validation process. During the events of participant observation, the CA conducted SSIs and noted the events to validate the causes, effects and the underlying relationships. The FGD-PTA-FGD sequence, the SSIs and cultural transect applied between-method triangulation through each of the workshops. In addition, the merging process from three different groups involved within-PTA-method triangulation. Furthermore, data sources from students, teachers and other events in which the CA participated applied personal (more specifically, group) triangulation.

Through this methodology, as opposed to participants' own collection methods and techniques to identify agreement or disagreement, each of the methods intended to come to a common understanding and shared viewpoints. This also allowed the CA to reflect on the observations and take the opportunity of "diffusion communication" (Rogers, 1995) on ICT in education. The CA used the checklist for validation and verification during the translation process with

the teacher of the institute, through formal and informal discussions with the students and the teachers, in conducting curricular and co-curricular activities, at the time of visiting the houses of students and teachers, while participating in administrative activities, during the observation of classes and while experiencing the life in the village. For instance, the fact that the institute's financial insolvency cause was mentioned by the three groups satisfied the verification part in itself and the validation was done by the principal, a member of the local managing committee (i.e., the parents' representative), the chairman of the management and the founder. Similarly, with respect to students' irregular attendance, it was observed that on most days only half of the 11th grade students were present, as indicated by the attendance record book and students' response in a face-to-face interaction.

In the quest for overcoming educational technology barriers, the researchers' analyses include the reconstruction of the problem tree, categorization of causes and the selection of three research directions for analyses.

The authors re-constructed the problem tree (as in Figure 1) from the merged list and the four problem-tree diagrams. Based on the relationships of the participants' problem trees, the authors categorized the causes as: teachers' deficiencies, students' challenges, academic institute's inabilities, rural disadvantaged context and national issues and central administrative barriers. These cause categories appeared to be grouped according to their association with roles or organizations. During the problem-tree reconstruction, the authors experienced that some of the dependent causes are related to several preceding causes. The tree diagram only allows a one-to-many relationship, but representing the reality requires a many-to-many relationship. For instance, most of the students and teachers do not have access to computer or Internet in their informal life due to the rural disadvantaged condition. Thus, in the diagram this could only be associated with the students' challenges and not the rural condition.

egories in previous literature and barrier categories and relationships of the current case. A representative number of previous studies have either built on or fall into the pattern of the following categories: extrinsic or first-order and intrinsic or second-order (Albirini, 2006; Ertmer, 1999; Snoeyink and Peggy A. Ertmer, 2001) material and non-material barriers (Pelgrum, 2001), teacher-level barriers (confidence, competence, and resistance to change and negative attitude) and school-level barriers (time, training, accessibility, technical support) (Bingimlas, 2009), resources, knowledge and skills, institution, attitudes and beliefs, assessment and subject culture (Hew & Brush, 2006), direct and indirect (Hew & Brush, 2006), teacher level, school level and system level (Balanskat et al., 2006), and micro level (individual or classroom), meso level (educational institute) and macro level (national organizations related to educational role) (Balanskat et al., 2006; Chan, 2011; Looi, So, Toh, & Chen, 2011; Pelgrum, 2001). Within these categories, the authors looked for and could find a trace of an evident pattern in the relationships and general categories of the causes of the merged problem tree. The cause categories can be related as micro-level or stakeholders' barriers (i.e., teachers' deficiencies and students' challenges), meso-level or institute's barriers (i.e., institute's inabilities), macro-level or national-level educational entities' barriers (e.g. national administrative barriers) and external disadvantages (e.g. rural disadvantaged context). Figure 2 shows this concept of categorization.

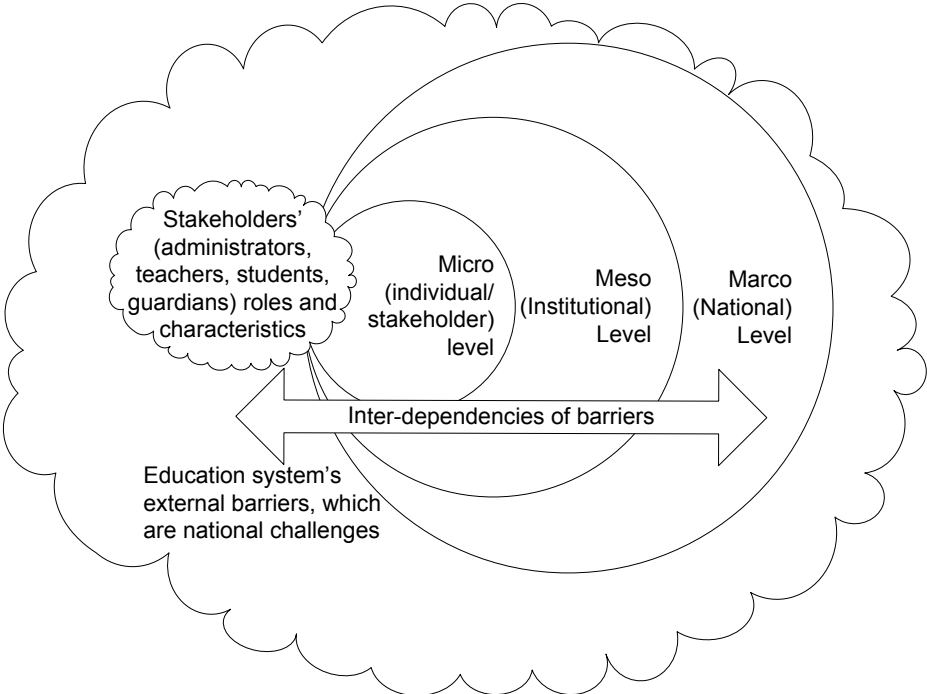


Figure 2. Framework of Barriers in Education- al Technology Integration and Adoption

The authors applied this framework and reported the causes of two barriers in Table 3. This mapping reflects the participants' viewpoints on the education system and the causes of barriers.

Table 3. Mapping Barriers into Macro-Meso-Micro Levels

Barrier	Long delayed acquisition and repair of equipment	Lab classes are not held regularly
Macro	Lack of government's planning and patronizing,	Lack of (vocational trade) teachers, low rate of persons passing the government's teacher registration examination, lack of (technology) skilled teachers.
Meso	Financial insolvency, no separate IT budget, principal requires approval from managing committee, lack of tech-support in school, lack of technically skilled teachers	Insufficient number of (working) computers, lack of computer accessories, lack of tech-support, insufficient number of laboratories, high student-computer ratio, low teacher retention, lack of teachers, unavailability of (computer) teachers despite repeated employment notices in the newspaper, lack of funds for teachers' honourium.
Micro	Lack of knowledge about – quality of equipment, quality of markets; lack of confidence.	Students lack motivation, students' irregular and low attendance, overworked teachers give priorities to other classes and tasks
External	Poor transport system infrastructure, lack of tech-support in close vicinity, lack of confidence in ICT seller and service provider, security vulnerabilities, access to required information for purchase decision, etc.	Unreliable electricity, lack of tech-support, troublesome commuting system.

Taking a step further from the above framework (Figure 2) and mapping (Table 3), the cause categories indicate change processes at organizational and individual levels. Roger's theory of diffusion of innovations established that innovation adoption involves changes at individual levels (i.e., stakeholders)

and the organizational (i.e., education and other) levels (Rogers, 1995). Furthermore, the application of PRA methods contributed as a diffusion communication strategy, both at individual level and at the organizational level.

Conclusion and Future Scope

In the preamble to this chapter the authors identified three interrelated questions: Firstly, which methodological approach and which methods would enable participants to extract and present the interdependent barriers to educational technology in a specific context? Secondly, in a situated case, how are these barriers related? Thirdly, do the barriers in the situated case indicate any pattern for theoretical contribution?

With regard to the first question, the authors have tried out participatory learning and action (PLA) methods in practice in an educational institute in rural Bangladesh. By applying techniques grounded in the PLA methods, the authors found that actors in and around the school increased their awareness by identifying a core problem in the school: students are not acquiring computer and internet-related vocational and practical skills. In this respect, it is important to stress that the problem or barriers leading to it are not surprising per se, as they are at the abstract level more or less in line with research from other parts of the world. The new thing is that the authors have verified the barriers and arrived at a thick description of the barriers in a rural Bangladeshi context and that local actors were heavily involved in the process of identifying and understanding these barriers. The local involvement in the identification and verification of the barriers also developed local awareness by making stakeholders talk and exchange viewpoints and experience. This prepared the change agent who was to integrate educational technology in the institute in order to deal with the barriers. The authors also expect that it has prepared the school for change. Considering the data analysed in this chapter, it is, however, not possible to sustain that the process did in fact prepare the school for change. For a solid answer, more research into the longer-term effect of participatory learning and action methods is needed.

With regard to the second question, the barriers are weaved together in a web of causes and effects. Categories of causes that appear in the research data include teachers' deficiencies, national issues, institute's inabilities, students' challenges and the rural disadvantaged context. Categories of effects include livelihood, education and citizen and social roles. These categories of problem causes and effects also indicate that they can meaningfully be categorized at different levels: the individual stakeholder micro level, the national political and administrative macro level and in-between them a school and local management meso level.

With regard to the third question, it is still difficult to theorize about the relation between problems, barriers and methods to integrate educational technology in rural contexts in developing countries. The authors attempt to start theory-building with a focus on the way barriers are connected across the micro, meso and macro levels because they appear to be so, but more research is needed to further develop and confirm this theory. The current research project

has therefore primarily viewed the meso and macro levels from the micro level – i.e., through the experience and expression of teachers and students, but other levels may view the problems and causes differently and may develop our impression of the way barriers travel across the levels.

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Paper IV

Moving Beyond Adoption Barriers Through Exploration of Teachers' and Students' Practice of ICT in Education — A Rural Bangladeshi Case

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MOVING BEYOND ADOPTION BARRIERS THROUGH EXPLORATION OF TEACHERS' AND STUDENTS' PRACTICE OF ICT IN EDUCATION—A RURAL BANGLADESHI CASE

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The literature on educational technology lacks empirical research on the social practice of information and communication technology (ICT) that would enable us to extend our understanding of the barriers to adoption and integration of ICT in the educational context. This study builds on Pierre Bourdieu's theory of practice, as a theoretical framework with which to examine the social practice of technology integration of the potential adopters. The first-named author's residential field study, undertaken with teachers, students, and staff of an educational institute in a disadvantaged rural area of Bangladesh, initiated the investigation by adapting participatory appraisal methods suitable to a rural context. The cultural capital in question includes knowledge about ICT product features and qualities, ICT skills, the level of education of family elders, and proficiency in English. Economic capital includes access to electricity, lack of knowledge of the ICT market, a transportation system, and ownership of ICT equipment. Social capital includes distrust of rural and semi-urban sources of ICT purchases, lack of motivation, and access to ICT. The high degree of credibility of foreign products and of family members living abroad is both social and symbolic capital. In addition to finding ways to facilitate the work of teachers and educational institutions in both formal and non-formal learning environments, the informal learning environment has to be considered. Diffusion strategies should consider holistic dispositions, not just any one of the learning environments.

Keywords: ICT4D; educational technology; developing countries; rural Bangladesh; participatory rural appraisal; theory of practice; diffusion of innovations; learning environment

1. Introduction

Any initiative for the diffusion of innovations should simultaneously consider the social practice of the potential adopters (Rogers, 1995). However, the literature on educational technology lacks empirical research on the social practice of information and communication technology (ICT) (Belland, 2009). For over three decades, the educational technology literature has been exploring and seeking to overcome the barriers to the adoption and integration of ICT in education (Ertmer, Ottenbreit-Leftwich, Sadik, Sendurur, & Sendurur, 2012; Ertmer, 1999; Hew & Brush, 2006; Law, Pelgrum, Plomp, & International Association for the Evaluation of Educational Achievement, 2008; Pelgrum, 2001). It is well established that teachers' and students' attitudes and beliefs are shaped by social practice in relation to ICT, both within and outside the educational institution, and that sometimes this means only minimal adoption of ICT, despite its availability and adequate capacity (Belland, 2009; Ertmer et al., 2012; Ertmer, 2005). It might be argued that the adoption of an innovation requires a sustainable change in the structure and functioning of a social system (Rogers, 1995). Such a change, in relation to the educational experiences of an individual's life, depends on three overlapping educational contexts, namely the formal, non-formal, and informal learning environment, which together constitute the social system and acculturate the social practice of education and ICT (Cilesiz, 2008). One barrier to adoption of ICT in the educational context is cognitive behavior, a particular type of mental activity (Belland, 2009). As Bruner noted, "[Y]ou cannot understand mental activity unless you take into account the cultural setting and its resources, the very things that give mind its shape and scope" (Bruner, 1996, pp. x–xi). Thus, interventions consisting of diffusing ICT in education should build on the clients' ICT practices in their learning environments. However, the literature on educational technology fails to propose a methodical way to study the educational use of ICT within the social practice that is constituted by the learning environment. Thus, to investigate social practice in relation to education and ICT, this study takes a mixed-method approach to explore the cultural setting, its resources in relation to a particular case. The intention is to point to some of the barriers that are inevitably linked to the social practices of ICT, particularly in the disadvantaged rural areas of developing countries (discussed in Section 3). Thus, this qualitative study is situated in Bangladesh, which has attracted much attention by its national strategic project, "Vision 2021: Digital Bangladesh" (A2I: PMO, 2009).

In the formal learning environment of K-12 education, Hew and Brush's (2006) review of 48 empirical studies from 1995 to spring 2006 identified 123 barriers and grouped them in six categories, of which the three major categories were: a) resources (40%), (b) knowledge and skills (23%), and (c) attitudes and beliefs (13%). The resources that were lacking were: (a) technology, (b) access to available technology, (c) time, (d) technical support, and (e) funding. Knowledge and skills were sub-categorized as: (a) lack of specific technology knowledge and skills, (b) technology-supported pedagogical knowledge and skills, and (c) technology-related classroom management knowledge and skills. Belland (2009) argued that, "moving beyond the study of barriers may provide the

knowledge necessary to allow technology integration to be achieved” (2009, p. 362). Belland proposed Pierre Bourdieu’s theory of practice (1977) as a theoretical framework with which to examine the social practice of technology integration of the potential adopters. In his article, Belland suggested that pre-service teachers may be assisted to integrate technology by empirical evidence of the relationship between their past experiences and their “dispositions” (ways of being and tendencies). However, Belland, conceding the difficulty of measuring dispositions perfectly or even directly, proposed the use of mixed methods within longitudinal studies. The present research considers the teachers, students, and their families in rural educational institutes in Bangladesh as potential adopters; participatory mixed methods were used to analyze their experiences and “dispositions” toward ICT in learning environments.

This paper takes as its point of departure the categories of barriers proposed by Hew and Brush (2006) and the exploration of “dispositions” suggested by Belland (2009). To avoid the complexity of measuring dispositions, this study focuses on the barriers of (a) technology, (b) access to available technology, and (c) knowledge and skills. In relation to these barriers, the potential adopters reported their “experiences” and “dispositions” through participatory analyses by answering the following three questions: 1. What ICT do you use? 2. What opportunities are there for you and your family to access ICT? 3. What uses of ICT do you consider to be educational? The answers raised three further questions, namely: 4. What is the status of the electricity supply in the learning environments? 5. What are the sources of supply of ICT equipment? 6. What is the educational level of family members? The interactive nature of the questioning guided participants toward identifying their learning environments as formal, non-formal, or informal. This process contributed to answering the research question: What is the practice among teachers, students, and staff of a disadvantaged rural educational institute in Bangladesh, in relation to ICT and education?

This paper is organized as follows. Following the introduction, Section 2 presents Bourdieu’s theory of practice, and discusses learning environments that situate the practice of ICT. Section 3 discusses motivation in the field of ICT for development (ICT4D) and educational technology. Section 4 elaborates on the participatory methods used in this study and the participants. Section 5 presents analyses and discussions, identifying the barriers in light of Bourdieu’s theory.

2. The Theory of Practice and Learning Environments

2.1. *The theory of practice*

The theory of practice, Bourdieu says, “is a temporary construct which takes shape for and by empirical work”; it provides “a set of thinking tools visible through the results they yield, but it is not built as such” (Wacquant, 1989, p. 50). The three most important thinking tools are: the concepts of practice, *habitus*, and field (Bourdieu, 1977; Jenkins, 1992). These thinking tools are vehicles for framing and facilitating investigation of

existing social practice, which, in this research, centers on ICT and its deployment in education.

Practice is located in space and time, consciously or partly consciously organized and orchestrated, and, though without (wholly) conscious deliberation, not without purpose(s) (Jenkins, 1992, pp. 69–71). This definition of practice, in the current research on the diffusion of ICT in education, is relevant to the discussion of practices of ICT in three learning environments (Section 2.2).

Habitus is “an acquired system of generative schemes objectively adjusted to the particular conditions in which it is constituted” (Bourdieu, 1977, p. 95). This research explores the generative schemes in the conditions of learning in rural Bangladesh. “The *habitus* is inculcated as much, if not more, by experience as by explicit teaching”; it commences during early childhood and continues to be formed throughout life (Jenkins, 1992, p. 76). The holistic conditions of life (e.g., the family’s social class, beliefs, schooling) form each individual’s *habitus*, or set of dispositions. Bourdieu uses the original Latin meaning of the word *habitus*—“second nature”—derived “from the thoughtlessness of habit or habituation, rather than consciously learned rules and principles” (Jenkins, 1992, p. 76). The word “disposition” encompasses three distinct meanings: the result of an organizing action, a set of outcomes, which Bourdieu describes as approximating structure; a way of being or a habitual state; and a tendency, propensity, or inclination (Jenkins, 1992, p. 76). In addition, there are at least three different views about how dispositions produce *habitus*: “objective conditions produce the habitus, the habitus is adjusted to objective conditions, and there is a reciprocal or dialectical relationship between them. Here one must distinguish between the habitus as embodied in individuals, and the habitus as a collective, a homogeneous phenomenon, mutually adjusted for and by a social group or a class. In the first case, habitus is acquired by individuals through experience and explicit socialization in early life. Life and subsequent experience is then a process of adjustment between subjectivity (habitus) and objective reality” (Jenkins, 1992, pp. 79–80). So, the practice of ICT in a social arena may or may not be used as a (wholly) purposefully selected medium for education.

In this research, the teachers and students in a particular context are studied as a collective. The research does not study the individual’s embodied habitus. Rather, the meanings and views of the set of dispositions (as Belland proposed) form the basis for identifying the generative schemes of *habitus*, i.e., ICT, access to ICT, schemes for and experiences of purchase of ICT equipment, and educational use of ICT.

A field is “a social arena within which struggles or manoeuvres take place over specific resources or stakes and access to them. Fields are defined by the stakes which are at stake—cultural goods (life-style), housing, intellectual distinction (education), employment, land, power (politics), social class, prestige or whatever. [...] Each field [...] is both the product and the producer of the habitus which is specific and appropriate in the field” (Jenkins, 1992, p. 84). This research explores the matters that are “at stake,” some of which are the principal barriers to ICT integration in education. The resources that are at stake “can be principally distinguished into four categories: economic capital,

social capital (various kinds of valued relations with significant others), cultural capital (primarily legitimate knowledge of one kind or another) and symbolic capital (prestige and social honour)” (Jenkins, 1992, p. 85). “The logics, politics and structure of the field shape and channel the manner in which ‘external determinations’ affect what goes on within the field, making them appear as part of the ongoing history and operation of the field itself” (Jenkins, 1992, p. 86). So, practice shapes habitus within a field. In this research, the learning environments constitute the field (Figure 1), which historically involves practice of ICT in relation to education and a certain habitus that has developed. If the field’s practices and evolving habitus can be discovered, then existing external determinants can be identified and further strategies can be planned for the smooth adoption of innovations. This research explores practice and habitus to identify prospective channels through which to diffuse ICT in the field (of learning environments), according to its existing logics, politics, and structure.

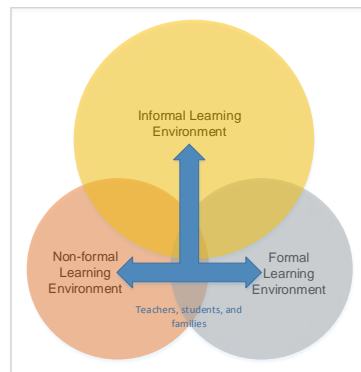


Figure 1. Application of Bourdieu's concept of field as learning environment.

2.2. Learning environments as contexts of education

Space, time, purpose, and consciousness about educational experiences constitute learning contexts (Gruenewald, 2003a, 2003b; Vadeboncoeur, 2006). Learning experiences and outcomes are formed by the learning environment in which they are set (Brown, Collins, & Duguid, 1989; Resnick, 1987). A context is a collection of factors such as location, organization, supervision, control, pedagogy, relationships, content, assessment, and schedules (Vadeboncoeur, 2006; Wellington, 2001). Contexts of educational experiences are conceptualized and distinguished as formal, non-formal, and informal learning environments (Brooks, 2011; Maarschalk, 1988; Reed & Loughran, 1984; Smith, 1988, 2006; Vadeboncoeur, 2006). Each environment represents a context, composed of micro-contexts, which are constellations of different attributes (Cole, 1998; Nicolopoulou & Cole, 1993; Zhao & Frank, 2003). The social practice and habitus of

ICT in relation to education are conditioned by the learning environments in which they are set, whether rural or urban or in a developing or developed country.

Formal learning environments include recognized educational institutions, mainly planned, hierarchically structured, evaluation-based systems starting from elementary school and continuing through university (Maarschalk, 1988; Smith, 1988, 2006). The capital at stake includes cultural capital in the form of knowledge, grades, and diplomas. Within the formal institution, traditional monetary capital is also at stake for managers and teachers, in the form of school budgets and salaries. ICT is also at stake, representing knowledge and providing opportunities for teachers and students, but at a cost. The use of ICT in the formal learning environment is shaped by the educational institution's space, institutional culture, norm-accepted activities, pedagogy, processes of academic administration, teachers' and students' personalities, and commonly employed teaching and learning activities (Barton, Tan, & Rivet, 2008; Brown et al., 1989; Khalid, Hossain, & Rongbut Sri, 2011; Nespor, 2000; Solloway, 2010). The focus of this research is secondary education (i.e., classes six to twelve).

Non-formal learning environments are institutionalized, structured, and planned, but consist of relatively flexible and adaptive organizational settings (which include training institute courses, after-school programs, in-service training, educational television and radio, and self-help groups), in which special needs-based skills are emphasized by both the learner and the agency (Ben Zvi Assaraf, 2011; Galipeau, 2010; Maarschalk, 1988; Reed & Loughran, 1984). Again, we find cultural capital at stake in the form of the development and exchange of knowledge, but, with a more flexible approach to organization and arenas, we expect to find social capital at stake as well in the communicative process. This research explores the non-formal learning environments of the study participants.

Informal learning environments are intimately connected with social activities and everyday life (Cilesiz, 2008; Vadeboncoeur, 2006), which enables individuals to acquire information, knowledge, attitudes, values, skills, and, in unstructured situations, from family, neighbors, and peers; at play and at work; and via the mass media, the marketplace, and the library (Cilesiz, 2008; Maarschalk, 1988; Smith, 1988). Informal learning can occur in any setting, is driven by conversation, and involves exploring and widening experience (Smith, 1988). Additionally, in this process, individuals (usually) are free to select the content of their learning (Dierking & Falk, 2003). Indeed, the informal learning environment constitutes the largest proportion of educational experiences, is highly effective (Illich, 1971; Resnick, 1987), occurs over a fairly long time (Vadeboncoeur, 2006), and has long-lasting results (Dierking & Falk, 2003; Reed & Loughran, 1984). The informal learning environment is thus receiving increasing emphasis and attention (Halse, 2009). In the informal learning environment, we expect to meet a wide range of forms of capital, but it is the cultural capital that is crucial, the emphasis being on knowledge and not on acquiring grades or diplomas. Social capital is an important driver in this environment, because it is what ties the participants together in a mutually engaging process.

The present study is evidence of the open-form nature of the informal learning environment but also of the importance of the family environment. Bourdieu also emphasised the family environment, which is given particular attention in this research.

3. Motivation and Scope of Selection of Context and Adoption of Methodology

Research into the barriers to adopting ICT in education is part of the broader domain of ICT for development (ICT4D). The ICT4D literature published between 1995 and 2010 shows three general dimensions of seven variables, i.e., ICT (telecommunications equipment and terminal devices), development (target group, domain area, and region), and research (research methods and discipline). Within ICT4D, health and education are the most commonly researched areas (Chepken, Mugwanya, Blake, & Marsden, 2012). In ICT4D studies, 47% of the target group were the “rural poor”, 60% of all ICT4D work was done in Asia and 30% in Africa, and action research was undertaken scarcely (Chepken et al., 2012). Drawing on the three dimensions, this section elaborates on our selection of context: why our study is situated in rural Bangladesh in relation to a private technical vocational education and training (TVET) institute, and why it explores ICT practice in an informal learning environment.

First, the development dimension guided the choice of a particular area and situation as the subject of the present research. The developing countries of the Asia Pacific region are increasingly deploying ICT in education (Akhtar & Arinto, 2009). Possibly the most notable scheme is “Vision 2021: Digital Bangladesh” (A2I: PMO, 2009; BOI: PMO, 2009)(UNESCO, 2010). The vision-led project has six strategic areas focused on facilitating adoption of ICT in education: general and TVET education systems, professional development of teachers using ICT, education-related citizen services, ICT literacy for students, ICT infrastructure and delivery channels, and ICT in educational administration (A2I: PMO, 2009). In addition, there is “special emphasis on TVET” (A2I: PMO, 2009), and the explicit objectives with regard to “education and research” in the National ICT Policy of Bangladesh 2009 (MoICT, 2009) motivated choice of the current case. Moreover, TVET is one of the key targets for assistance by UNESCO (Hollander & Mar, 2009). Bangladesh has a population of about 142 millions (BBS, 2011), about 72% of which is rural (World Bank, 2012). More than 55% of the TVET institutes are situated in rural areas (BANBEIS, 2011). Of 2,981 TVET institutes, 2,730 are private, and they employ about 80% of teachers of technical education and train more than 70% of technical education students (BANBEIS, 2012). Therefore, in order to study the social practice and barriers to adoption of ICT in educational contexts, this qualitative study is appropriately situated in a rural, private, TVET institute.

Second, Hew and Brush (2006) reviewed empirical investigations into the barriers to educational technology, and identified four main limitations: (a) incomplete description of methodology (i.e., research duration, number of participants involved, and inter-observer and intra-observer reliability); (b) sole reliance on participants’ self-reported data (i.e., interviews or surveys); (c) short in duration (i.e., five days to less than two

years); and (d) focus primarily on the teacher and what went on in the classroom. So, the authors' stand on a transformative paradigm advocates a participatory approach and mixed methods for the development of "more complete and full portraits of our social world through the use of multiple perspectives and lenses [... to explore a] greater diversity of values, stances and positions" (Somekh & Lewin, 2005, p. 275). This holistic view is supported by the theoretical grounds of current research, that is, the theory of practice (Bourdieu, 1977) and the theory of diffusion of innovations (Rogers, 1995). Thus, the mixed methods and the principles of participatory learning and action (PLA), formerly known as participatory rural appraisal (PRA), were applied for data collection (Chambers, 2008; Narayanasamy, 2009). Additionally, the PRA methods offered two-way communication between the target group (that is, the TVET institute's stakeholders—teachers and students) and the field researcher or change agent (Rogers, 1995, Chapter 10).

Third, this research studies the practice of ICT in the learning environments of rural Bangladesh, and looks for social patterns of resistance to the adoption of ICT in relation to education. Experiences of using ICT are embedded in the cultural and social context in which the use take place (Arora 2012; Lee & Winzenried, 2009; Sutherland et al., 2000; Zhao and Frank, 2003; Mumtaz, 2001). People in rural areas typically have strong connections with their surrounding community; thus, ICT can have a strong impact on the community (Katz, 2003, p. 121). Conversely, the same strong connections may be the source of resistance to innovation. In Bangladesh, the barriers include lack of ICT support infrastructure (lack of electricity, reliable internet connectivity), lack of resources (availability, supply, maintenance, and up-to-date equipment and accessories), insufficient funds, vision (national and institutional), and planning (at government and school levels), political factors, social and cultural factors, corruption, teachers' attitudes and beliefs about ICT, lack of knowledge and skill, and lack of time (Khan, 2012). Moreover, the barriers found in developing countries are similar to their counterparts in developed countries. Gilligan (2005), reviewing the Irish "rural" case, contends that some of the problems are associated with "rural areas" and some with "rural dwellers." In particular, Gilligan (p. 165) suggests exploring other types of "rurality," for example, "how urban commuters are using ICTs at home in rural areas." Similarly, this research studies how TVET students and teachers are using ICT at home in rural areas.

4. Methodology

Bourdieu constructed the theory of social practice and society from empirical investigations on what people are, what they have, what they know, what they do, and what they say—amidst the wider pattern of social life (Bourdieu, 1977). As in Bourdieu's ethnographic exploration of the *habitus* and homologies (1977, pp. 143–158), the principal researcher's participation in the social and educational life of respondents in the present study facilitated participatory methods of data collection and analysis. The first-named author conducted pre- and post-diffusion communication studies as part of the

current project. The participatory methods described in this paper were undertaken during the early phase of the first field study, between September 2011 and January 2012.

4.1. *The participants*

Tofail Ali Technical School and College (TTSC) is a private vocational institute and Tofail Ali Junior School (TAJS) a junior secondary school situated in the village of Khagatua, part of Ratanpur of Nabinagar, Brahmanbaria, in the Chittagong division of Bangladesh. The selection was based on acquaintance with the founder. Both institutes have the same management body and are taught by a shared group of teachers. Table 1 summarizes details about the student participants of the population studied.

Table 1. Student population of the institutes.

Institution	Class	Male	Female	Total
Tofail Ali Junior School	Six	15	39	54
	Seven	19	32	51
	Eight	25	25	50
Tofail Ali Technical School and College	Nine (4 trades)	20	27	47
	Computer	08	11	19
	Poultry	05	04	09
	Dressmaking	-	12	12
	Electrical	07	-	07
	Ten (4 trades)	25	22	47
	Computer	06	09	15
	Poultry	09	-	09
	Dressmaking	-	13	13
	Electrical	10	-	10
	Eleven (2 trades)	23	16	39
	Accounting	13	10	23
	Computer	10	06	16
	Twelve (2 trades)	25	12	37
	Accounting	16	04	20
	Computer	09	08	17
	Total	149	173	322

Among the 17 participant teachers, 9 were male and 8 were female. Twelve of the teachers were long-term permanent residents of Khagatua village, one teacher was from a neighboring village, and the remaining four had been residing in the village since 2005 (after joining the institution).

4.2. *Methods—Participatory Rural Appraisal (PRA)*

PRA involves research, action, and education; it has been epistemologically established by Wilmsen and Elmendorf (2008, pp. 12–14), and is widely used in development projects (Capriello, 2012; Ejlersen, Poole, & Marshall, 2012). the present research adopted PRA methods (Chambers, 1994a, 1994b, 2008). PRA was formerly known as Rapid Rural Appraisal (RRA), and has now been renamed participatory learning and action (PLA) (Chambers, 1994). Many scholars have investigated the wide variety of PRA methods and their applications in great detail (Chambers, Howes, Lipton, &

Streton, 1996; Chambers, 1994a; Mukherjee, 1997, 1998; Narayanasamy, 2009). Unlike previous studies, which involved only partly literate participants, this research with schoolchildren and their school-centered learning enjoyed the advantage of having a large group of rural participants, classrooms in which to conduct exercises, and peers for validating and verifying data. Table 2 summarizes the application of the methods, which are then briefly discussed. Topics and methods were all field-based. All methods were facilitated in the native language of the participants, that is, Bengali. At least one teacher played the role of a co-facilitator, who was selected by the class or group. The co-facilitators were the principal, one lecturer, and one part-time teacher (who is also an alumnus of the school).

Table 2. Application of PRA to the study of fields in the *habitus* of ICT and education.

Resources in field	Principle Methods	Habitus	Participants
Access to ICT	Focus group discussion (FGD)	What ICT do you use and where?	Classes VI–XII, teachers, & staff. Participation was subject to slight differences in attendance.
Access to electricity	Participatory census	How do you access electricity?	
ICT ownership	Participatory census and FGD	Devices used in the houses	
Use of ICT for educational purposes	Participatory census, FGD, and cultural transect	What uses of ICT do you consider educational?	
Education and profession	Participatory census and FGD	Family members, age, highest academic qualification, and current occupation	Classes VII–XII.
Purchase of ICT resources	Participatory census, mobility map, and FGD	Who purchased which device and from where?	Class VII, VIII, and IX.

4.2.1. Focus group discussions (FGD)

The FGDs (Morgan, Krueger, & King, 1998; Narayanasamy, 2009) involved unstructured questions for the first group of participants and semi-structured questions for the subsequent groups. The first round of focus group was with a class of students from TTSC and a group of employees.

4.2.2. Participatory census

The participatory census (Mukherjee & Chambers, 2004, p. 20, 225) method provides demographic details or individual household data in a geographic area, using symbols and colors to present different information. There are two methods of conducting a participatory census: (i) the social map method and (ii) the card method (Narayanasamy, 2009). In the social map method, participants normally use a village map as a base map on which to plot all the houses with their unique numbers and data about the households. In the card method, the data about households are typically written on cards, using symbols and household numbers. The card method was adopted in this research, using paper for participants to write on, and the data were in the form of written tables or lists.

Each group was then encouraged to summarize the data and present it on the classroom blackboard. To eliminate redundant data from the summary, each class of students made a list of their siblings in other classes. For example, the census on “unit family members and purchase of ICT devices” in the families of class eight shows that a student has a sibling in the same class. So, the cards of both the students were given the same unique number as a reference to one household, and the cards were found to validate each other during the summarization exercise. In addition, participants from neighboring households validated and verified one another. The students represented 205 families from Khagatua village and 50 families from 10 neighboring villages.

4.2.3. *Cultural transect*

A cultural transect enables the researcher(s) “to traverse through the ‘life’ of a person, a subsect of the village, or the village itself over a period of time (it may be a day, or a week, or more). It involves attaching oneself to a person, subsect, or village and following through on a journey of observations and discussions to discover patterns of daily life and why they are what they are” (Mascarenhas, 1992). The principal researcher lived with a rural family and acted as consultant to the academic institutions involved in this study. As a change agent in the field, the researcher facilitated administration, teaching, fundraising, official meetings, in-house training, student counselling, winter clothes distribution for charity, and other operations besides—as an integral part of being a member of the institution and the rural community. Thus, the daily logs, notes, images, videos, face-to-face interactions and activities, interviews, and participant and non-participant observations constitute the cultural transect.

4.2.4. *Semi-structured interviews and observation*

Semi-structured interviews (SSI) (Mikkelsen, 2005; Narayanasamy, 2009, p. 296), participant observation (Chambers, 1994b), and non-participant observation were an important part of the cultural transect, which enabled data to be validated as opportunities opened up.

4.2.5. *Mobility map*

“A mobility map is a map drawn by the people to explore the movement pattern of an individual, a group or a community” (Narayanasamy, 2009, p. 97). This study conducted mobility map to identify the capitals at stake in relation to the purchase of ICT resources.

4.2.6. *The validation process—triangulation*

Triangulation (Grandstaff, Grandstaff, and Lovelace, 1987) is a process whereby data may be validated. It is the process of progressively learning, cross-checking, and approximating, through progressive plural investigation. The process involves diverse ways of “assessing and comparing findings from several, often three, methods, types of

item or sets of conditions, points in a range or distribution, individuals or groups of analysts, places, times, disciplines, investigators or inquirers and combinations of these” (Chambers, 1994b). This research conducted between-method triangulation by applying three methods of data collection to a single topic (Figure 2a). In addition, triangulation of the personal triangulation (Figure 2b) type (Narayanasamy, 2009, pp. 32–34) was conducted by validating (Mikkelsen, 2005) the same data in the same space or in the same situation and during the same time interval.

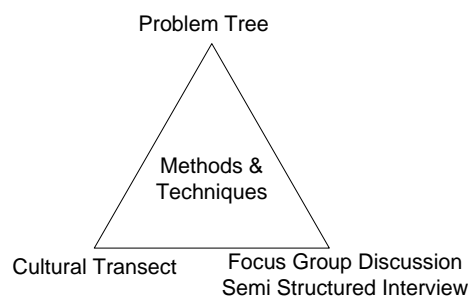


Fig 2a. Between-method triangulation.

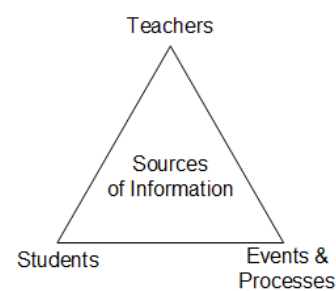


Fig 2b. Personal triangulation.

5. Data Analysis and Discussion

This discussion of qualitative data portrays a partial view of typical rural Bangladesh practice in relation to ICT and education. Participatory analyses of the students and teachers form the practice, *habitus*, and field of the two institutions and 11 villages. The *habitus*, or set of dispositions, is situated in the rural areas, wherein sits the field constituted by the learning environments. The analysis identifies the resources or forms of capital that are at stake in the field.

5.1. What are the technologies used in information and communications?

Each class of students and a group of teachers and staff members participated in ice-breaking FGDs on access to and use of ICT within the institutions, households, and elsewhere. With few differences, a list of devices and features was identified, as follows: (1) mobile (commonly used features are SMS, Bluetooth, memory card, media content, audio/video recorder, and camera), (2) television (terrestrial and satellite), (3) radio (as a device and mobile feature), (4) DVD/CD player or recorder, (5) computer (desktop and laptop), (6) Internet access with computer or mobile, (7) newspaper, and (8) loudspeaker or miking. Additionally, Khagatua village has a unique practice called *tin-e-bari* (“bitting tin”) at the morning market to inform people about village *shalish* (Banglapedia, 2012), or informal adjudication. However, none of the villagers accessed the Union Information and Service Centre (UISC), a telecenter (Akther & Georgesen, 2011; Hussain & Tongia, 2009) situated in a nearby village. Exceptionally, one household owns a multimedia projector, which was sent by an expatriate family member. The family and relatives

occasionally use the projector to watch movies. A shopkeeper uses a “pen drive” or flash drive and a DVD player, gifts from an overseas-employed cousin.

The participants said that the use of ICT depends heavily on access and availability of electricity and the convenience and reliability of purchasing ICT. A participatory census was therefore conducted to explore access to electricity, and a mobility map was used to explore social practice with regard to ICT purchase.

5.2. Electricity: the prerequisite for ICT adoption

Table 3 shows that access to electricity is the greatest barrier for one-fourth of the households of Khagatua village. *Para* are smaller geographic areas, made up of villages, most of whose residents are in oral communication with one another. About half of the village households can access an electricity supply either directly or through a relative's or neighbor's subscription. A similar situation exists in the neighboring villages. Administrative barriers associated with the approval and installation of a new subscriber connection force householders into such a state of dependency. The electricity supply is unavailable from about two to three hours per day to two to three days at a stretch; availability is worse in summer and best in winter. National statistics show that only 47% of the population is served with electricity, per capita consumption is only 156 Kwh and the Rural Electrification Board consumes 37.73% (BPDB, 2009).

Table 3. Electrification of households in Khagatua village.

<i>Para</i>	Households	Population	Rural electrification	Solar	Total	Total %	No access	Own meter
Uttor	31	179	19	2	21	18	10	14
Purbo	19	109	13	0	13	11	6	8
Khane	39	240	35	1	36	31	3	25
Nath	24	123	18	0	18	16	6	12
Poschim	12	65	8	0	8	7	4	6
Boliara	12	76	7	1	8	7	4	6
Modhyo	19	101	11	2	12	10	7	9
Total	156	893	111	6	116	100	40	80
%			71.15	3.85	74.36		25.64	51.28

Referring to Bourdieu's concept of field, it might be argued that, in the learning environments of rural Bangladesh, electricity access and availability are “at stake” and the practice of ICT depends on the dispositions of this stake. Of the four resource types mentioned in the concept, electricity, being an economic resource, is the most relevant here.

5.3. *Mobility in regard to the purchase of ICT resources*

Triangulation based on the participatory census, mobility map, and FGD methods revealed that the four major barriers to purchase of ICT are: 1. lack of knowledge about ICT product quality and features (i.e., cultural capital), 2. lack of markets and ICT product options in rural and semi-urban areas (economic capital), 3. distrust of rural and semi-urban sources (social capital), and 4. high credibility of foreign products and foreign-born residents (symbolic capital). Many rural households depend, for the decision to purchase, on family members who are working and living in urban areas or foreign countries. Figure 3 reflects this pattern (i.e. location and frequency) with regard to the purchase of mobile phones, which is similar for other device purchases. The decision to purchase and the actual purchase are done by income-earners: father, oldest son or daughter, uncle, cousin, or brother-in-law of the family. These purchases fall into one or more of three categories: a financial contribution to the household, a gift, or a loan, which the family pays back.

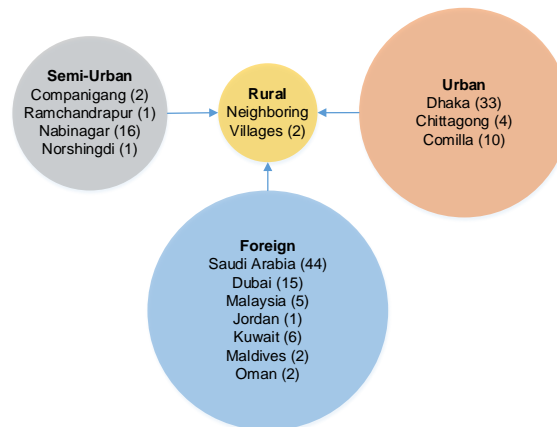


Figure 3. Mobility map of mobile phone purchase source and frequency.

5.4. *Formal education in rural families*

Students in classes ten to twelve and their teachers claimed that the use of ICT in different learning environments is related not only to knowledge about ICT but also to the level of formal education achieved by family members. These participants also claimed that a low level of formal education among the elders of the rural families is one of the failings of the rural environment, which neither facilitates nor encourages the use of ICT for educational purposes. In order to investigate these claims further, data were reviewed on each family unit that included parents of participants and any siblings aged 14 years or above. The authors discarded data from the sixth class, which were not thought to be reliable, and merged the tables, carefully eliminating census data relating to siblings who were studying in different classes of the institution.

Table 4. Education levels of parents and siblings aged 14 years or above.

Education Level (Class)	Percentage	Cumulative
No formal education (0)	17.3%	17.3%
Primary (1-5)	18.6%	35.9%
Junior Secondary (6-8)	17.3%	53.3%
Secondary (9-10)	27.2%	80.4%
Higher Secondary (11-12)	13.0%	93.5%
Tertiary (13-above)	6.5%	100.0%

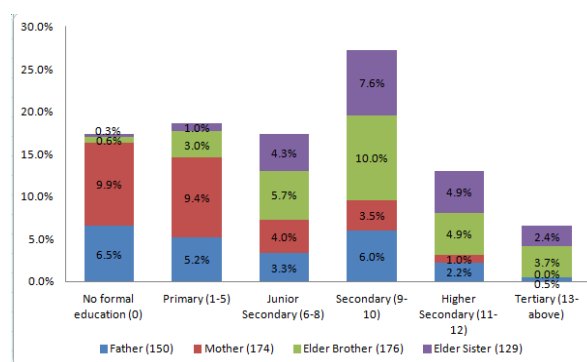


Figure 4. Education levels of parents and siblings aged 14 years or above, by position in the household.

Figure 4 and Table 4 show that 35.9% of family members aged 14 years or above had not exceeded primary level education, and most of them were parents. ICT use was discouraged, and ICT for educational purposes was judged to be “surprising”. Operating ICT devices with English interfaces requires proficiency in the English language. Very few students’ family members inquire about or facilitate learning activities in the informal environments. So, in Bourdieu’s terms, the field of the informal learning environment lacks facilitation by an educated elder. The level of formal education, English competency, and knowledge about the educational use of ICT are cultural capital; a negative attitude toward use of ICT as a learning tool is symbolic capital. These schemes of *habitus* fundamentally impede the desired development of ICT in the service of education.

5.5. Practice in relation to ICT and education

Ownership, access, and educational uses of ICT were reported on by the students from 156 households of Khagatua village and 50 households from 10 neighboring villages.

The results revealed that the practice of ICT is primarily formed by the informal learning environment. The use of ICT in formal settings is limited to knowing how to operate a desktop and office applications. The non-formal training of teachers and staff effected very little change in practice, which is confined to teaching file handling and document drafting on a desktop computer or administrative tasks such as drafting official letters. Considering *habitus* as the rurally situated and adjusted generative scheme, the practice of ICT in the informal learning environment may be understood by stating that the ownership of and subscription to ICT resources are economic capital.

5.5.1. Newspapers

Khagatua's lack of good transportation system leads to receiving daily newspapers at the end of a day or later. These communication challenges are economic capital. Fewer than 8% of students mentioned that a newspaper is brought into the house once or twice a month. Only two households in the neighboring villages subscribed to between two and four newspapers per week. TTSC subscribes to a daily newspaper, which is accessible in the teachers' common room. Every day, a few students from classes nine to twelve, in the absence of a teacher, borrow the newspaper for a period. Usually the students skim through the headlines and read about sports and entertainment. However, there is hardly any guidance (i.e., social capital) from family elders or teachers on utilizing newspapers for purposeful learning.

5.5.2. Television

In Khagatua, 50.64% of households own a television, but viewership covers 96.79% households. Similarly, in the neighboring villages, 62% own a television, but viewership covers almost all families. Unlike in other villages, Khagatua residents do not have access to a cable operator, and watch the state-owned terrestrial channel, Bangladesh Television (BTV). Educational (*shikkhamuluk* in Bengali) programs are found on UNICEF's social awareness channels, general knowledge and English programs on the BBC, and programs about agriculture, health, and the national parliament may be viewed on the national channel. In almost every class and every village, there are one or two students who are not allowed to watch TV by the family elders. Participants reflected that through PRA mediated facilitation meanings and views of TV programs as the "only form of entertainment" were changed to an explicit "learning purpose". Socially an educational activity is given higher status than an entertaining one. Similarly, ICT in relation to education is regarded as social honor — a form of symbolic capital, which had been being less honorable and discouraged.

5.5.3. DVD players

Ownership of DVD players is 30.77% in Khagatua and 26% in other villages. Educational uses of DVDs are programs from BTV and other television channels in Bangladesh and India. While the purchase of DVD players and time spent using them are

for the purpose of entertainment for elders of the family, there is scarce but growing use of children's learning programs. Entertaining content is much cheaper and more readily available than educational content, and is accorded higher value. Thus, is is this lack of an explicit objective to achieve educational goals through the adoption of DVD contents — a lack of social capital that causes lower adoption of this form of ICT.

5.5.4. Radio

In Khagatua village, 47.44% of households and 76% of other villages' households listen to the radio. Whether people listen to the radio depends on whether the household owns a radio set, availability of a radio feature on personal mobiles, and access to either one of these. In most of the households, radio is accessed through mobiles. The radio stations are state-owned, international and private. Most popular are music and news programs. Other programs include Islamic, health, sports, and entertainment content. Only one student mentioned an educational program on Bangladesh Betar, namely *BishwaBichitra*, a program on current affairs. The learning environments do not encourage (lack of motivation is a form of social capital) listening to news or educational programs.

5.5.5. Mobiles

Mobile phones are the most common ICT devices in rural households (above 97.5%). Mobiles are shared among the members of a family and neighbors, and about 55% of households have more than one mobile. There were found to be 309 mobiles among 893 people (of all ages). From the seventh class, typically at 14 years of age, students start owning a mobile phone. Table 4 shows mobile phone ownership (symbolic capital) among students by age and sex; ownership among male students is higher than among females, and senior classes own more mobiles than junior classes. Of 207 students, 27% own a mobile. Owing to inadequate network coverage, these rural users subscribe to three of the six operators in Bangladesh.

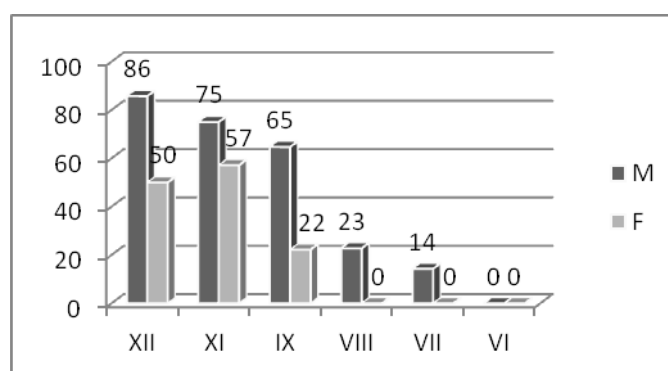


Figure 5. Percentages of mobile ownership by class.

Apart from voice calls, mobile features the participants reported using include listening to the radio, SMS, memory card-based entertainment content, camera, Bluetooth, games, multimedia player, and recorder. Apart from the Islamic media, the other content providers purvey entertainment. SMS services are used for obtaining board examination results, subscribing to news bulletins or alerts, and participating in radio shows. Use of the camera is constrained by the storage capacity of the mobile. About 37% (of 57) students of Khagatua have a memory card in their mobile, and 35% of households (of 156) have at least one mobile phone with a memory card. Multimedia content may be purchased from shops or the nearby village markets, where the buyer can pay for full loading of the memory card or per file. Users typically share content via Bluetooth. Participants identified a common pattern of ownership, collection process, personal use, and practice of sharing. For instance, the skills related to mobile storage, Bluetooth use, and content are transferred, often rapidly, from young people to receptive elders. The tendency to share resources and knowledge is a form of cultural capital, which is one strength of learning environments in the rural context.

The Internet is accessible from at least one mobile in about 40% of the students' households. However, the students had never seen anyone else using the feature, and only four male students from classes ten to twelve had used it themselves. Typical uses are downloading music, video and pictures; conversely, searching and browsing are infrequent activities. While "how-to knowledge" about the use of the Internet is present, the absence of "awareness knowledge" and "principles knowledge" in relation to educational use are the resources at stake (Rogers, 1995, pp. 165–166). In addition, knowledge may be allowed to remain at a low level unless a need for it is experienced (Rogers, 1995, Chapter 5).

5.5.6. *Computers*

Only three male students from tenth, eleventh, and twelfth class have access to a personal computer. Two of them access the Internet via a mobile phone and PC suite application. One uses both an EDGE modem and his mobile with the PC suite. The computer owners expressed confidence in using the tools and troubleshooting. Learning is problem-based, using trial and error and informal interactions with computer-expert friends and relatives from urban or semi-urban areas. The educational offer of the computer and the Internet includes gaining skills on MS Word, Excel, the video converter tool, the dictionary, searching for information on the web, and showing multimedia content to members of the family. In only four of the households do some elder siblings of the students use a computer. Computers are employed in the household for entertainment or for learning purposes. Shared access is always supervised by an expert, who is the designated owner. Many users lack not only skills but also the opportunities to gain skills. Low skill (i.e., cultural capital), high cost (i.e., economic capital), and low access to support services (i.e., economic) make people wary about sharing.

5.5.7. Use of ICT among teachers and their families

The practice with regard to ICT for education in the families of the teachers and staff is not much different from that found in the students' families, except that the educational level of the household members is generally higher. For these people, disadvantaged rural conditions and the lack of knowledge sharing with ICT adopters (i.e., cultural capital) left them with little scope to observe, try out, and realize the applications and advantages of ICT.

In the 17 households of teachers and staff members, about 71% have a television, about 35% listen to the radio, none owns a computer, every teacher has at least one mobile, and almost every adult member owns a mobile. Teachers read newspapers at their institution, rather than at home.

Despite being at liberty to use the computers in the labs, only three (less than 18%) teachers use a computer for personal, professional, or academic activities. The school principal and the computer instructor necessarily use computers for academic administration and teaching activities, respectively. The only teacher who uses a computer of his own accord stated that he did so “for special purposes only,” a “special purpose” being, for example, composing a CV and or writing an application.

The pattern of usage of radio, television, and mobiles is similar to that found in the students' households. Exceptionally, one teacher subscribes to SMS-based news headlines and sports updates and results; he also communicates via SMS with teachers at the other institute in order to collaborate on preparing questions for the state examinations.

Although the teachers had higher educational achievements than members of the other households, they were persuaded to adopt ICT by the urban practices of technology, for example, DVDs on animations, rhymes, and TV programs for children's learning. In addition, financial solvency gave educated adults the confidence to experiment with the use of such devices.

6. Conclusion

What is the practice among the teachers, students, and staff of a disadvantaged rural educational institute in Bangladesh, in relation to ICT and education? The first step toward answering this research question was to introduce Bourdieu and his theory of practice.

Drawing also on the work of Belland (2009), we used the theory of practice to map the barriers in terms of the various forms of capital that were at stake, as defined by Bourdieu. The cultural capital at stake consisted of knowledge about ICT product features and qualities, ICT skills, the level of education of family elders, and proficiency in English. Economic capital included access to electricity, lack of knowledge about the ICT market, a transportation system, and ownership of ICT equipment. Lack of social capital leads to distrust of sources of purchase of ICT in rural and semi-urban areas, lack of motivation or encouragement, and poor access to ICT. The high credibility of foreign

products and family members residing abroad was both social and cultural. This close intertwining of cultural and social capital is crucial to understanding and working with barriers to the integration of ICT in the practice of the educational institutions studied here, but to fully understand how crucial they are, we must also look to economic capital.

Lack of economic capital influences access to ICT and thus the development of practice with ICT. When there is no money, one cannot buy, but in the present case we have an institution and a lot of individuals that *can* afford to buy if only they manage to convince their family to support them in the purchase. However, if the purchase is possible or already has been made, another barrier appears, the fear of breaking or damaging what is after all an expensive piece of equipment. Securing sufficient economic capital is mainly about (family) relations (social capital), and getting a return on investment requires knowledge (cultural capital).

So, our study revealed a healthy exchange of capital in some areas and a lack of exchange of capital in others. If one lacks knowledge and lacks trust in people who may or may not know what ICT equipment to purchase and how to use it, then the decision not to risk a large amount of money appears to be a sound one (bad investment of family money will also lead to a loss of social capital). Based on the present research, we suggest that the barriers will not be overcome merely by introducing more money in the form of computers. Computers will, of course, be a help, but without knowledge, trust, and, for that matter, self-confidence, no one will venture to use the ICT. The relationships between cultural, social, and economic capital suggest that development of a more advanced practice with ICT calls for the development of more cultural and social capital.

This brings us back to the methodological foundation of this paper. Data were collected through a participatory approach involving stakeholders of the school, that drew its success from the presence of an individual who was known and trusted in the community. In the present case, the principal researcher had sufficient cultural capital, thanks to his education, and sufficient social capital, thanks to family connections, to spark the participatory process. The educational institution also appeared to be a good platform for the diffusion of cultural and social capital in the community, but we cannot conclude that this will be so in every case.

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Paper V

Integrated Resources and Training Facilitation: A Strategic Priority When Promoting ICT in Developing Countries.

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Integrated Resources and Training Facilitation - A Strategic Priority When Promoting ICT in Developing Countries

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Abstract

In a rural context in a developing country purchasing a computer and connecting it to the Internet is in itself difficult, even when the lack of money is a minor issue. These issues prevent individuals in rural communities from familiarizing themselves with educational technology and ICT in general. The present study investigates the specific barriers to buying and utilizing ICT and ways in which these barriers can be overcome in a case study involving stakeholders from an educational institution in rural Bangladesh. Through a transformative methodology and a phenomenographic approach to the analysis (Larsson & Holmström, 2007), interview data on the decision-making experience of computer purchases, and the after-purchase experience of learning computer-related skills, the integration of the technology and the skills in interviewees' (students and teachers) learning environments is analyzed. The barriers to purchasing a computer fall in four major categories: Cultural, financial, infrastructural, and knowledge barriers; with knowledge transcending the other barriers. When addressing the barriers to facilitate purchase of a computer locally situated knowledge is crucial. The study concludes that more research is needed to fully understand the diffusion and development of knowledge and inclination to purchase a computer.

Keywords: *Phenomenography; Educational technology; Barriers to technology; Diffusion of innovations; Promoting ICT; Training facilitation.*

Introduction

It is an under-researched issue that individual learners (i.e. teachers, students and others) are a key source of information about barriers to the adoption and integration of information and communication technology (ICT) in formal schooling, non-formal learning environments (e.g. after-school programs and in-service training), and informal learning environments (e.g. family, peers, neighbors, work, play, telecenters, and mass media) (Cilesiz, 2008), especially as regards to the adoption of ICT in developing countries (Abdullah-Al-Mamun, 2012; Khan, Hasan, & Clement, 2012; Lashgarara, 2012). Strategies to facilitate the integration and adoption of educational technologies had been focused on educational institutions (Chigona, Chigona, Kausa, & Kayongo, 2010; Tondeur, van Keer, van Braak, & Valcke, 2008) and teacher centered (Ertmer, Ottenbreit-Leftwich, Sadik, Sendurur, & Sendurur, 2012; Ertmer, 1999, 2005). This research studies the barriers through a learner-centered and learning environment-oriented approach; here, every stakeholder in the education system is a *learner* of ICT. Thus, at an aggregate level, this diffusion research examines how the 'what' and 'how' aspects of the barriers can be addressed through facilitation to teachers and students for purchasing and training on computer and Internet.

The field of educational technology has been confronting ICT adoption and the integration of barriers for over three decades (Ertmer et al., 2012; Ertmer, 2005; Hew & Brush, 2006;), at both institutional and individual levels. In the formal learning environment of K-12 education, Hew and Brush's (2006) review of 48 empirical research studies from 1995 to spring 2006 identified 123 barriers and grouped them into six categories; three categories are delineated as teacher-level barriers, with the following relative frequencies, respectively: a) resources (40%), (b) knowledge and skills (23%), and (c) attitudes and beliefs (13%). This research considers the three categories of barriers as individual-level barriers or as educational stakeholders' (i.e. students, parents, teachers, staff, etc.) barriers. Participatory research by Khalid and Nyvang (2013) explained such barriers as micro-level or educational stakeholder's barriers. In addition to the formal learning environment, individuals may also experience these three categories of barriers in the activities of non-formal and informal learning environments (Hussain & Tongia, 2009; Khan et al., 2012). This research emphasizes that an individual's barriers are typically associated with teachers, educational institutions, and state agencies (Chan, 2011; Ertmer et al., 2012; Ertmer, 1999). In addition, the encounters with barriers situated outside the formal learning environment are largely neglected (Belland 2009). Moreover, definitions of *technology integration* reflect such neglect. For instance, Belland (2009, p. 354) defines "*technology integration* as the sustainable and persistent change in the social system of K-12 schools caused by the adoption of technology to help students construct knowledge"; the social system is therefore confined to the formal environment only. This definition does not recognize the uniqueness of each individual's own system of learning, which is constituted of different activities and different learning environments. Therefore, this research suggests that one way to circumvent the barriers of educational technology is to consider stakeholders (i.e. teachers, students, parents, etc.) as the focus of diffusion interventions. Intervention strategies should also consider diverse and prospective learning activities at an aggregate level; that is, in each of the three learning environments.

The ownership of a personal computer, internet access, professional experience, and personal experience play significant roles in the integration of ICT in education (Teo, 2006; Tezci, 2011). In addition, intervention strategies that emphasize distribution of and training in the integration of ICT in educational institutions have resulted in much disappointment, for both the provider and the receivers, because of the lack of technology literacy (Amiel, 2006; Cuban et al., 2001). Moreover, while ownership and technology literacy in the developed countries are high, the developing countries are lagging far behind, particularly Bangladesh (Abdullah-Al-Mamun, 2012; Ertmer et al., 2012; Hussain & Tongia, 2009).

The present study addresses the individual educational-stakeholder's barriers to ICT adoption and integration in education by focusing on barriers to ownership of a computer and Internet connectivity, and approaches to circumventing these barriers. Thus, this study is situated in a technical vocational education and training (TVET) institution in rural Bangladesh, where the first author played the role of *change agent* (Rogers, 1995) to facilitate the adoption and integration of computers and Internet in the learning environments of teachers and students. "A change agent is an individual who influences client's innovation decisions in a direction deemed desirable by a change agency" (Rogers, 1995, p.336). Amidst diverse barriers in Bangladesh (Khalid & Nyvang, 2013; Khan et al., 2012), the *change agent* facilitated the purchase of laptops and accessories by interest-free installments, on-site after-purchase training, and additional facilitation during two field studies conducted in 2011 and 2012, totaling 7 months.

To uncover and unfold individual level-barriers to educational technology; specifically barriers to ownership of a computer and Internet connectivity, and approaches to circumventing these barriers, this article begins with a review of known individual level barriers to educational technology in a development context. Then, it moves on to presenting the methodology, analysis, discussion, recommendations, and conclusion.

Individual-Level Barriers to the Adoption and Integration of Educational Technology

This section reviews the barriers to educational technology at the individual level. This review is called the 'bracketing' method (Ashworth & Lucas, 2000), which pre-supposes the 'categories of description' of phenomenographic analysis. In addition, the following review discusses the motivation behind situating the case (i.e. a vocational education institution from a rural area) and the embedded units (i.e. teachers and students) of this study in rural Bangladesh.

In educational technology literature, the terms 'adoption' and 'integration' are defined with significant similarity, and the difference is lacking clarity (Belland, 2009). This research employs 'adoption' as the decision-making process (Rogers, 1995) of the purchase and purposeful-learning of a computer and Internet technologies; 'integration', on the other hand, refers to the appropriation of technological skills in the 'learning activities' (Tondeur et al., 2008; Wachira & Keengwe, 2010).

This study builds on the review paper by Hew and Brush (2006). Thus, following a discussion on barriers at the individual or micro level (i.e. resources, knowledge and skills, attitudes and beliefs, and subject culture), the intervention strategy of this research is elaborated as follows. The lack of *resources* is classified as: (a) technology, (b) access to available technology, (c) time, and (d) technical support. A fifth sub-category of *resource* is funding (Hew & Brush, 2006; Rogers, 2000). *Knowledge and skills* can be categorized as: (a) lack of specific technology knowledge and skills, (b) technology-supported pedagogical knowledge and skills, (c) technology-related-classroom management knowledge and skills. Hew and Brush (2006) also found that teachers' *belief* may include their educational 'beliefs about teaching and learning' (i.e. pedagogical beliefs), and their 'beliefs about technology' (Ertmer, 2005); beliefs also determine a 'person's attitude' (cited Bodur, Brinberg, & Coupey, 2000). The intervention strategy of this research attempted to address the *resource* barriers of technology and the access to available technology by providing purchase facilitation. In addition, the barrier of the lack of specific technology knowledge and skills and technology-supported pedagogical knowledge and skills was addressed through learning-environment focused, problem-oriented and within-institution training. The phenomenographic analysis identifies the experience of this intervention, which results in the identification of other associated barriers, which provides greater insight into clients' experiences and future considerations for the change agents and agencies.

The barriers are far more severe among the disadvantaged educational contexts of the developing countries, mainly in their rural areas (Abdullah-Al-Mamun, 2012; Hussain & Tongia, 2009; Kessy et al., 2006; Khan et al., 2012; Lashgarara, 2012; Sharma, 2003). Most importantly, about 70% of the world's poor people are living in disadvantaged rural areas which deserve greater attention (World Bank, 2012). Moreover, the developing countries of the Asia Pacific region increased the emphasis on 'ICT in education' (Akhtar & Arinto, 2009). Conceivably, the most notable among them is the "Vision 2021: Digital Bangladesh" (A2I: PMO, 2009; BOI: PMO,

2009), which focuses on six areas of ICT in education: General and TVET education systems, the professional development of teachers using ICT, education-related citizen services, ICT literacy for students, ICT infrastructure and delivery channels, and ICT in the educational administration (A2I: PMO, 2009). Thus, the purchase of computers and the training facilitation for teachers and students in a rural TVET institution in Bangladesh will offer a contribution to both the national and the international agendas.

Bangladesh has a population of 142 million people (BBS, 2011) and 72% of its inhabitants live in rural areas (World Bank, 2012). Over 91% (2730 of 2981) of the TVE institutions of Bangladesh are private, and these host about 80% of teachers and more than 70% of students of the technical education (BANBEIS, 2012). In addition, more than 55% of the TVE institutions are located in the rural areas (BANBEIS, 2011). This research draws attention to the under-researched field of private TVET institutions and the rural secondary and higher secondary institutions in Bangladesh.

The public polytechnic institutions of Bangladesh are facing significant barriers to providing computer and Internet services: according to teachers' responses in a recent study, these barriers are lack of technology (55%), training (55%), knowledge (38%), skills (32%); administrators pointed at high expenditure (69%), lack of skilled personnel (47%), students and teachers prefer the traditional method (53%) (Abdullah-Al-Mamun, 2012). The opinion of the administrative decision makers indicates that the adoption and integration of ICT might be far-reaching. Because the administrators usually prefer traditional methods, considering ICT adoption as a high expenditure issue, and struggling to find ICT-skilled personnel, institution-led *authoritative decision to adopt* (Rogers, 1995, p.207) is fundamentally restricted. Therefore, this research explored the potential of the agent-facilitated *optional or collective innovation-decision* (Rogers, 1995, p.207) at the individual level, i.e. among educational stakeholders.

Methods

In the preparation phase of the present study we found ourselves to be in a difficult situation. With an interest in studying barriers to purchasing computers for learning purposes in a rural area of a developing country we faced three major problems: (1) We didn't have access to any useful cases to study; (2) Not being truly familiar with rural areas of a developing country we expected to have great difficulties in asking the right questions even if we had found a case; and (3) Our purpose was not only knowledge but if possible we would also induce change. We found a way to meet those challenges in the transformative paradigm. Transformative researchers "believe that inquiry needs to be intertwined with politics and a political agenda" (Creswell, 2003, p.9) and should include an action plan for change "that may change the lives of the participants, the institutions in which individuals work or live, and the researcher's life" (Creswell, 2003, p.9).

This paradigm argues for participatory methodology and mixed-method approaches for the development of "more complete and full portraits of our social world through the use of multiple perspectives and lenses" (Somekh & Lewin, 2005, p.275). It does so to gain an understanding of "greater diversity of values, stances and positions" (Somekh & Lewin, 2005, p. 275).

The transformative paradigm encouraged us to play an active role in creating a case to study, thus inducing change. It told us that a participatory approach would engage us in a learning process together with locals situated in a rural area; thus, helping us to build a shared vocabulary and mutual understanding of the barriers.

The transformative paradigm does not generally begin with a theory but “generate or inductively develop a theory or pattern of meanings” (Creswell, 2003, p.9) during the research process. However, unlike other paradigms, transformative research emphasizes social justice and marginalized people (Creswell, 2003, p.9).

Data Collection

This research was designed as a *single-case* study with *embedded units* (i.e. teachers and students) (Stake, 1995) and was situated in a private, vocational, and rural TVET institution in Bangladesh. The purchase and training facilitation recipients, 6 teachers and 2 students (see Table 1), were interviewed during the second field study face-to-face in Bangladesh and re-interviewed a year later over Skype-to-mobile to follow up on the purchasing experience. The interviewees were those who didn't own a computer but expressed the firmest interest in purchasing one. Our data are thus biased towards a positive attitude towards computers from the beginning which we will of course keep mind when discussing the results of the study.

Table 1. Recipients of Facilitation and Participants of Interview

Units	Designation (in 2011)	Degree	Subject/Discipline
Teacher 1	Principal	M.Sc., B.Ed.	Statistics
Teacher 2	Lecturer	M.Com.	Accounting
Teacher 3	Lecturer	M.A.	Bangla
Teacher 4	Assistant Teacher	M.A., B.Ed.	English
Teacher 5	Assistant Teacher	B.Sc., B.Ed.	Mathematics
Teacher 6	Trade Instructor	Diploma in Electrical Engineering	General electrical works
Student 1	12 th grade, graduated	S.S.C. Voc, Computer	HSC BM, Computer
Student 2	12 th grade, Enrolled in undergrad, Accounting	S.S.C. Voc, Computer	HSC BM, Accounting

Data Analysis

This research study is positioned within the category of “experimental phenomenography” (Hasselgren & Beach, 1997) and the transcribed text is analyzed by application of the phenomenographic methodology (Larsson & Holmström, 2007; Marton, 1981, 1997) as follows.

1. Read the whole text.
2. Read again and mark where the interviewee gave answers to the main interview questions.

3. In these passages, look for *what* the focus of the interviewee's (i.e. student's or teacher's) attention is and *how* she/he describes her/his way of deciding or doing. Make a preliminary description of each teacher's and student's predominant way of experiencing the phenomenon.
4. Group the descriptions into categories based on similarities and differences. Formulate categories of description.
5. Look for non-dominant ways of understanding.
6. Find a structure in the outcome space.
7. Assign a metaphor to each category of description.

Interview transcription is practiced in different ways, among which this study uses *denaturalism*, "in which grammar is corrected, interview noise (e.g., stutters, pauses, etc.) is removed and non-standard accents (i.e., non-majority) are standardized" (Oliver, Serovich, & Mason, 2005, p.1273). In this way, the transcription process involved two phases. First, two of the authors transcribed and translated the interviews from Bengali to English. Secondly, a professional English language expert was consulted for the carefully selected text from the transcriptions.

The first author conducted the field studies and interviews; other authors contributed to translation, transcription and methodological analysis. The term 'researcher' within the quoted texts of the transcription and the term 'change agent' elsewhere refer to the first author. The term 'client' refers to the targeted stakeholders of the institution and the interviewees.

Results

The phenomenographic analysis of the interviews displayed variations and similarities among the interviewees' experiences. The participant observation by the change agent contributed significantly in conducting and analyzing the interviews with sufficient empathy, which is recommended by Ashworth and Lucas (2000). In addition, the change agent's live-in field experiences contributed in validating and verifying the responses. The change agent lived, worked, trained, and shared experiences with the school community. The agent's experiences within the interviewees' households, the institution, and elsewhere provided opportunities to verify the reflections in the interviews. In some cases, the interviewees' reflections were over-statements of their actual practice or achievements. In such cases, the change agent (i.e. interviewer) validated the claim by re-questioning the interviewee to reflect the actual experience. After the analysis, the selected quotes from the interviews and the categorization of the descriptions were verified with the participants. Considering the convenience of the interviewees, this verification was conducted through emails and mobile discussions. This section analyzes the experiences of the interviewees in each of the three phases of the broad phenomenon. In addition, the experiences of the barriers (i.e. 'what') and the circumvention of the barriers (i.e. 'how') are described to unfold the ICT adoption barriers.

The Experience of Barriers to Purchase Computer and Internet Technologies

In the first phase of the study of the broad phenomenon of individuals' adoption and integration processes the participants responded to two main questions: (1) *What barriers had*

been preventing your decision to purchase or the purchase of a computer and Internet technologies (Barrier 1-25 in the analysis)? (2) How did you overcome these barriers and acquire the computer resources (Strategy 1-23 in the analysis)? The responses to the 'what' question resulted in the categories of barriers which were pre-supposed through the bracketing method. The answers to 'how' questions are the related intervention experiences that solved or circumvented the barriers.

Lack of Specific Technology Knowledge and Skills

Barrier 1 & 2: Lack of knowledge about the features and quality of technology; Lack of knowledge about reliable markets/shops to purchase from. Each of the interviewees mentioned these two barriers. These barriers are related to both the decision to purchase (Teacher 3) and the actual purchase (Student 2).

Teacher 3: Which type [desktop/laptop] of computer should I buy? From where should I buy? Which brand should I buy? If I go to buy, since I do not know much about computers, then if it is good or bad, if it is suitable for me – even determining these would have been a problem.

Student 2: I did not have enough knowledge on the quality of computers (which brand and what functions I should ask or look for), the price and if the seller is reputed as a reliable seller and service provider. Although I had visited a computer fair in Dhaka [city] and I also visited some shops where I considered purchasing a desktop, I could not decide and could not tell my father about the purchase.

Strategy 1 & 2: Each of the interviewees mentioned that the training, workshops, and discussions were persuasive; most importantly, the change agent's knowledge and sourcing of the technology were reliable.

Teacher 3: When you discussed with us and told us that you are ready to help us, then without hesitation I left these decisions on your shoulders.

Student 2: Later, when you arrived, I discussed with you and I was convinced that in the given electricity condition and other flexibilities, I should purchase a laptop instead.

Barrier 3: Lack of knowledge about how to use a computer and for which purposes. Except Teacher 1, all other interviewees mentioned that their previous knowledge about how to use a computer had been theoretical and their previous hands-on experiences were not related to purposeful activity in real life.

Teacher 2: Previously I knew a little bit of computer use. But I did not know how to use the Internet and how the Internet can be useful

Teacher 3: In fact, a computer is a useful device – this I knew before. But in reality, we did not know what we should do after buying a computer.

Strategy 3: Training, problem-based learning and purpose-oriented activities with computer and Internet with the change agent were described to explain how these experiences persuaded the decision to purchase.

Student 1: *Mainly, I was eager to know how everyone and I can talk face-to-face with my brother and sister, who are staying abroad. I did not think that anyone else but you can do it. For example, when I talked using your mobile, over Skype, at that time I became more eager. Maybe if a laptop is bought for me [by brother and sister] and if you create an account for me, I shall be able to do it [use Skype] on my own.*

Attitudes and Beliefs

Barrier 4 & Strategy 4: Lack of technology know-how led to lack of inspiration. The participants' expression was translated as 'inspiration', which refers to internal spirit. Apart from Student 1, other participants mentioned this barrier and related it to the decision to purchase.

Student 1: *Previously, I did not even have the opportunity to know about computers. I learned a little from ninth and tenth grades, as I studied with computer trade...Later, from college [eleventh and twelfth grades] I started feeling that I can use a computer. After learning many more ways of using a computer and the Internet from your training, I got inspiration to buy.*

Teacher 4: *One doesn't become eager to do something if one doesn't learn it, isn't it? So, when you showed us how to use it, persuaded us, taught us how to use it, how it can be used and we saw the usefulness, then we thought about buying it.*

Barrier 5 & Strategy 5: Lack of trust in vendors. Each of the interviewees believes that there is very high chance that a buyer of an IT product will be swindled if s/he lacks confidence and the ability to evaluate product quality, product price and the vendor's reputation. The change agent's expertise was deemed to be sufficient.

Teacher 2: *"We do not have much knowledge about computers and the quality of computers. I had the possibility to be cheated or swindled. Since you are a computer know-how person, if I purchase through you, there is no chance to be cheated or swindled. Otherwise I might end up with a low-quality product with a high price, and typically they behave very badly if we go for any kind of support in the future."*

Barrier 6 & Strategy 6: Purchasing a product from a foreign country is more reliable. While distrust in the native vendor is reflected by each adopter, two (S1, T6) of them had family members staying abroad who facilitated the purchase of laptops.

Teacher 6: *I had the opportunity to purchase from a foreign country. I thought it would be a better quality than buying from Bangladesh.*

Barrier 7 & Strategy 7: Lack of motivation. Each of the participants identified this as one of the major barriers and related it to the purchase decision. The term 'motivation' refers to external persuasion or a push.

Student 1: *I had a plan to buy but I was motivated when you [change agent] trained us, showed us how to use laptops for various purposes and suggested us to buy one. I thought*

that I can ask my brother and sister, who are staying abroad, to send a laptop. With my own computer I shall be able to learn more from you.

Teacher 6: *Most importantly, no one motivated me to purchase a computer. So, I promptly decided when you asked us to purchase a laptop instead of a desktop, which can support up to three hours of power backup during power outage, it is handy and I can carry it along. I always had the ability to purchase a computer but I just needed sufficient motivation. I was motivated by the persuasive discussions with you.*

Barrier 8 & Strategy 8: Fear. The word ‘fear’ was used as fear of destroying or causing malfunction of the expensive device, getting stolen, afraid of the device remaining unused due to lack of time.

Teacher 5: *I have many classes in the institution and I remain very busy. If I purchase, I was afraid I shall not be able to give enough time to learn and to use the computer....I got courage from you [change agent].*

Teacher 1: *You assured us that if we do not drop it in the water or throw it, then usually it does not get non-operational or damaged [‘nosto’ in Bengali].*

Barrier 9 & Strategy 9: Prevailing distrust in the society. The acceptability of a change agent depends on the community and its members’ inter-personal trust relationships. The change agent’s (i.e. researcher’s) ability to persuade depends on her/his socio-political status among the clients (i.e. teachers and students).

Teacher 5: *I would not have believed anyone else [if offered similar facilities]. You are in a project in our institution and you are in connection with the founder [of the institution]. That is why we purchase through you. If anyone else had told us, I/we might not have bought.*

In case I had felt such a need, from others than you [someone other than the agent], I would have also consulted with those who knew [about computers]. I would have shared [my plan to purchase] with them. I would have purchased after trust- building, which might have delayed that decision. It would have taken more time to decide.

Resources

Barrier 10 & Strategy 10: Lack of electricity. As this barrier fundamentally prevents the decision to purchase an electricity dependent technology item, the interviewees’ related this to the purchase decision and choosing between a desktop and a laptop.

Teacher 1: *Your [the change agent’s] idea of buying a laptop instead of a desktop was appropriate for us, because we can work even when there is no electricity.*

Barrier 11 & Strategy 11: Lack of support services. This barrier might prevent the decision to purchase. However, the availability of convenient and informal support for basic troubleshooting might circumvent this barrier.

Student 1: *I did not have opportunities to know if anything goes wrong with a laptop or a computer. Since you are here and others also have learned, I can get help now.*

Barrier 12 & Strategy 12: Weak Mobile network connectivity. Each respondent identified this as a major barrier, which results in unreliable Internet connectivity. The connection strength varies within different locations of the same household's space.

Teacher 1: *Because of mobile network disturbance I am now sitting in my courtyard to talk to you [for the interview].*

Barrier 13 & Strategy 13: Lack of trainer to teach desired skills. Despite curiosity to know the use of computers and the Internet, there was little opportunity to learn the desired skills. Each of the participants considered this to be a barrier to the purchase decision. The respondents considered the anticipated future training and facilitation from the change agent as methods by which to circumvent this barrier (e.g. Teacher 6).

Student 2: *I went to Dhaka to learn computer but even there they did not teach me so many things as you [change agent] did [before the purchase decision]. They only taught me how to do typing. But you were teaching some skills. If I have my own computer, I shall be able to practice at home and I shall be able to remember this. That would also boost my interest.*

Teacher 6: *Twice I had saved money to a buy computer, but then I thought who is going to teach me how to use it, and what benefits am I going to get from it? So, later I spent my savings for other purposes.....I thought that if I buy now, I shall be able to get training from you. I can get help when I face a problem and if I want to learn something new.*

Barrier 14 & Strategy 14: Lack of time. Professional workload leaves little time for learning and integrating new technology. The interviewees did not mention 'how' this barrier was addressed.

Teacher 1: *The institutional workload [for teachers] is very high. So, we will have to allocate time. But we were convinced that if we buy, it will save our time and will ease our tasks.*

Teacher 5: *I have many classes in the institution and I remain very busy. If I purchase, I was afraid if I shall be able to give enough time to learn and to use the computer.*

Lack of Financial Strength

Barrier 15 & Strategy 15: Income level is far too low to purchase at one instance. Except Student 2, other recipients of the instalment facility mentioned this as a major barrier.

Teacher 5: *I did not have enough money. It would have been tough to buy with full payment. The instalment process was convenient.*

Teacher 3: *It was difficult for us to purchase at once with our salary. Such difficulty is faced by all those of us who bought a computer. We received the computer at hand by paying a relatively small amount as the down payment. So, it was easy for us to purchase.*

Subject Culture

Barrier 16 & Strategy 16: Subject culture and folk pedagogies that limit the use of technology. The traditional folk pedagogies of teaching which a teacher experienced as a student or a student teacher, shape the attitudes and beliefs of a teacher (Belland, 2009). A subject culture or the way to teach a subject can be defined by the practices in a school or by an individual teacher. Teacher 2, Teacher 3, Teacher 4, and Teacher 5 mentioned similar barriers among the teachers. The change occurred through observation, trial and interaction with the change agent.

Teacher 2: As an accounting teacher I used to think that I do not need to have these [computer and Internet] rather these are only for computer people.

After your arrival when you showed me the use of the Internet through a mobile phone, helped me creating emails and a Facebook account in my mobile, showed me how to search in Google, read newspapers etc., I tried myself and found that I can find much information from the web. But when I tried to download some content or even read a newspaper, it gives the message 'insufficient memory'. I realized that a mobile will not be sufficient, I need a laptop. I felt that a computer is required for any individual and not just people with specific tasks.

The After-Purchase Experience of Learning to Use the Computer and Internet Technologies

Each of the participants mentioned similar experience in response to the questions “what skills did you learn after the purchase of computer and Internet technologies?” and “how did you learn?”

Barrier 17: Use of the Computer: Recognizing indicators and external parts of the laptop, controlling the mouse and painting by the use of paint software, handling files and folders, transferring data by using flash drives and CDs, editing images, using Microsoft Word and Excel, English typing, Bangla (Bengali) typing by using Avro phonetic keyboard software, Bijoy keyboard software, listening to music and watching video content, using multimedia content for teaching in the classroom and for children.

Barrier 18: Use of Internet: Connecting a modem, subscribing to an Internet package, browsing and searching by using three different browsers; operating web-based applications for educational administration; reading newspapers, listening to the radio from websites, downloading files, searching and applying for jobs through job portals; using email, Facebook, and Skype.

Every interviewee mentioned within-institution training workshops and problem-based facilitation with the change agent. In addition, the known experts within the institution provided skills to one another through cooperation, observation and problem solving.

Teacher 1: Although I learnt to use a computer from previous training and I could type some essential documents using office applications, I learned more during your training workshops at the institution and during various situations of problems and the facilities of

the computer and Internet ...sometimes from Rajib [ad-hoc teacher cum office assistant], who learned the most among us from you [change agent].

Integration of the Technologies and Skills in the Learning Environments

The analysis of this third phase of the intervention involved responses to two main questions. These were: (1) *In what activities of your learning environments did you use your computer and Internet technologies and related skills you gained?* and (2) *How did you experience your technologies and your skills for those learning activities?* Responses to the 'what' question are analyzed to identify categories of activities. Responses to the "how" question offered qualitative insight into participants' integration of technologies in their learning activities and the changes in their attitudes and beliefs.

Barrier 19 & Strategy 17: Classroom activity

Teacher 2: *In the absence of an English teacher, the contents of the smart classroom that he/she is supposed to teach, I could teach those in the English classes only because I have a computer and I have those contents in my computer. I could practice those at home. I did not get any training from the NGO and got the training from you [change agent]. Since I gained some courage and skills, I took the initiative to teach those....*

Barrier 20 & Strategy 18: Preparation for class and self-study

Teacher 2: *Previously I did not have the ability to use accounting lesson content in a typed and printed form. After my purchase, I gained the ability to do that.*

Student 2: *I use two [software] dictionaries [English-Bengali] for mathematics, because my mathematics book is in English.... It takes less time to search from a computer dictionary than from a paper dictionary.*

Barrier 21 & Strategy 19: Educational administration. Since mid-2011, the TVET board of Bangladesh has enforced the use of the Internet for educational administrative activities with each institution, which includes curricula, regulations, and notices, annual planning, class scheduling, curriculum content, syllabus, admission, registration, assessment and evaluation. Until this purchase and training facilitation, the institution was dependent on external services for Internet-dependent administrative information and activities.

Teacher 1: *Yesterday, at quarter to one [at noon] a student rang me that class nine's result was published [in education board's website]. I called up Rajib [ad-hoc teacher cum office assistant] but both of his [mobile] numbers were unreachable. Although this result cannot be accessed by mobile, the young students became excited about it [result] and tried getting it by mobile. After the prayer I sat down with my laptop. At 10-11 at night I promptly gave the results to all the students who inquired. ...it did not take even five minutes. ...this saved money and time; I did not have to worry about a person [whom to send to publish the information otherwise] and the probable dissatisfaction of inquiring students. Now, every one or two alternative days I search relevant websites for important information of the board and the directorate. ... Recently, I have also been getting some important [official] emails. ... On the 19th of this month [Feb 2013] at quarter to nine at night, DG's [Director General of TVET board] approval of five of our newly-appointed teachers' MPO [monthly payment order] was published as part of a list. ... I rang each of*

the teachers to tell them that their MPO had been approved ... I also informed other teachers from other institutions in Nabinagar [area];

Teacher 2: *As I am the ICT committee convener, the principal asked me to assist Rajib for marks entry to the BTEB website. I have done part of the form filling and submission, and I supervised the task. I also found some errors and helped in correcting those. I found my own promotion and seniority from the website and I could inform the principal.*

Barrier 22 & Strategy 20: Learning and social networking through Facebook

Teacher 2: *Through Facebook sharing I could learn many things. One of my friends shared one piece of Islamic information about prayer. I could learn that. I try to follow that. I also shared that. Similarly, I learn much information and share this. For example, I could not watch games on my TV and other news, but I could follow recent news and updates, which I also shared on Facebook. ... My alumni association could not reach me over the mobile, and they informed me over email. I could attend that reunion because I had my own laptop and Internet. ... I also uploaded some pictures [on Facebook] and I could share these with my students, [who are living] in various places [countries]. I could also chat and share mobile numbers with them.*

Barrier 23 & Strategy 21: Internet-mediated access to newspapers

Teacher 3: *In our village we do not get the newspaper delivered within that day. We get newspapers after one day. So, if I sit with my computer, I can get the newspaper immediately.*

Barrier 24 & Strategy 22: Learning and communication opportunities for family and society

Teacher 2: *One of my friends is staying in the UK. He forgot my number and he could not contact me. He emailed me and luckily I was in Dhaka and I could meet him. Without email I could not have met him after many years. It's because he knew my email address. I had once informed him about my email address when he called me from UK.*

Student 2: *I can talk [with cousins] on Facebook, that's why I do not have to use email. From your [change agent] multimedia content for teaching English, my child got some benefits. For example, in the content, there is a game on the appropriate use of articles and numbers. My kid is not supposed to know that. As part of the game he practiced those. At the age of 7 I did not expect him to learn these so quickly, but he did. I believe it is because of the computer and the content.*

Barrier 25 & Strategy 23: Engaging Children in learning activities. Five of the six teachers mentioned that the children in the family enjoy watching multimedia learning content.

Teacher 1: *Today, for example, is Friday right [emphasizing weekly holiday]. This morning I told my two young daughters that I shall play with them and show them the computer. I showed them the computer for an hour, and I could keep them engaged at home till now. They saw Sisimpur [Bengali UNESCO program like Sesame Street] and rhymes, the rhymes about alphabets. Showing these, I could keep them at home. Otherwise, they do not want to stay at home.*

Discussion and Recommendations

The present study set out to uncover and unfold individual level-barriers to educational technology; specifically barriers to ownership of a computer and Internet connectivity, and approaches to circumventing these barriers.

During the analysis it has been shown that barriers and corresponding strategies to circumvent them fall in 7 categories:

1. Lack of specific technology knowledge and skills
2. Attitudes and beliefs
3. Resources
4. Lack of financial strength
5. Subject culture
6. The after-purchase experience of learning to use the computer and Internet technologies
7. Integration of the technologies and skills in the learning environments

All the seven categories of barriers and strategies are related to culture (most prominently 2, 5, 7), financial strength (most prominently 3, 4), infrastructure (3, 6, 7) and knowledge (most prominently 1, 6, 7).

Culture is culture within subjects (what is important and how do we teach it?) and culture within the local community and probably greater areas of rural Bangladesh (those who want to purchase a computer often cannot find anyone they trust to take advice or purchase from). It appears that even if it is traits of the culture we are looking at lack of knowledge is a common denominator too. What the community really lacks is one or a few experts on educational technology and sufficient knowledge spread in the rest of the community so that the experts are acknowledged as experts. In the present study local innovators trusted the change agent sufficiently to let him assist them to purchase a computer. Thus, it can be recommended that change agents stay long enough in a rural community to induce a change in culture through dissemination of knowledge. More research is needed before one can say how long a change agent needs to be part of the community for a sustainable change in the culture to take place. More research is also needed to find out how to persuade other than innovators to purchase computers.

Financial strength is another great barrier to ICT and educational technology. In the present study money from outside has helped the school to purchase some ICT but sufficient scaffolding from the change agent also released local money for purchase of ICT. It is possible that more locally accepted knowledge will release more local money for further funding of ICT and educational technology. A barrier within the financial strength barrier is the fear of breaking something because it cannot be replaced. The fear of breaking something appears to prevent local knowledge development because no one dares to experiment and learn by trial and error. It can be recommended that future development initiatives supports local investment in educational technology and ICT in general but further research is needed for a

sustainable business model of a funding scheme to be developed. In Bangladesh micro-funding is known but at the moment it doesn't extent into educational technology.

The infrastructure barriers are the ones that are the most difficult the deal with locally. It is difficult (and sometimes dangerous) to travel to an urban area for purchase of ICT and back to a rural community. Another infrastructural issue is the lack of good Internet connections. The authors have no solid recommendations to offer here. Arguing for better infrastructure is easy but the funding is difficult. Thus, one can recommend more research into sustainable models of infrastructures, specifically Internet, for rural areas in developing countries.

Knowledge is important for educational technology to succeed. This study has shown that a change agent can disseminate knowledge and start a positive trend towards local knowledge development with regards to educational technology and ICT in a broader sense. On-site training before purchase offers opportunities for *observability*, *trialability* and *relative advantage* for the innovation (i.e. ICT in education) adoption decision (Rogers, 1995, p.207); training and facilitation after purchase enables the problem-based and learning environment-oriented integration of ICT. In the present study the main focus is barriers and circumventing barriers to purchase of computers and already at this level that to a typical European appears very basic; it is almost not worth devoting attention to a lack of knowledge is a barrier to educational technology. This leaves us with the recommendation that much more attention is devoted to disseminating basic knowledge on computers so that individuals within the local community will feel to be able to take active part in purchasing decisions. More research is needed before we fully understand the importance of rural knowledge and rural knowledge development when it comes to educational technology and the different components of a purchasing decision.

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Paper VI

From Change Agent to Sustainable Scaffolding

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From change agent to sustainable scaffolding

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Educational institutions in rural Bangladesh are faced with multiple problems and barriers when implementing ICT in teaching and learning. The paper reports from an ethnographic action research project set up in rural Bangladesh to induce change in a specific institution and to inform research about the barriers to ICT. The authors set out to research how a researcher and change agent by means of a participatory process can construct and distribute knowledge together with local stakeholders so that the local stakeholders ultimately can take charge of a continued development. It is concluded that the change process in the institution has begun with the action research project, but also that it is probably too early to say for sure if the change is sustainable. With respect to doing action research in rural Bangladesh it is concluded that an action oriented approach is promising. The action research approach gave the authors access to study an enactment of problems in relation to the implementation of ICT which could not have been foreseen solely based on a traditional ethnographic study.

Keywords: educational technology, formal learning environment, ICT4D, diffusion of innovations, barriers, smart classroom, integration, adoption

1. Introduction

This paper reports from a research project that explores, analyses and deals with barriers to the integration and adoption of information and communication technology (ICT) in relation to the educational contexts of secondary educational institutions in rural Bangladesh. The project is part of a cluster of research projects with similar aims to deal with challenges to education in developing countries. The cluster of projects is hosted by Aalborg University and the research center e-learning lab – center for user driven innovation, learning and design. We also want to mention that the research is carried out by researchers with rather different backgrounds; one that grew up in the capital of Bangladesh and just recently relocated to Denmark to continue his research and one that grew up in Denmark and primarily did research in Denmark until 3 years ago. We do, however, share a common interest in ICT as a driver and tool for development of education – especially in developing countries. Moreover we share a keen interest in understanding and facilitating processes that develop educational institutions with ICT. With this paper we report from the part of the overall project that deals with the involvement of the school community in the development process. We do so because existing research on ICT for development (of educational institutions) tend to restrict itself to mere observation of existing practices (e.g., Ertmer et al., 2012; Ertmer, 1999; Hew & Brush, 2006; Khan, Hasan, & Clement, 2012). Action research has been applied sparingly (Chepken, Mugwanya, Blake, & Marsden, 2012). From a change perspective mere observation has little to offer. We thus want to research how a researcher and change agent by means of a participatory process can construct and distribute knowledge together with local stakeholders so that the local stakeholders ultimately can take charge of a continued development?

The paper is organized as follows: First, a review is conducted on barriers to the integration and adoption of ICT in relation to the formal learning environment of Bangladesh and its rural areas. Second, the context of the research project is presented, Third, a description of the EAR methodology and methods. Fourth, blended with the EAR process, a chronological description of the facilitation process is presented, integrating an analysis of the barriers that can be addressed and those that continue to present problems. Finally, to

summarize the process of facilitation, ethnographic action research is warranted as a preferable diffusion facilitation alternative.

2. Barriers to the integration and adoption of ICT in education

Much research demonstrates the benefits of educational technology on attitudes on instruction, attitudes toward subject matter, and student achievement (Lowther, Ross, & Morrison, 2003; Wenglinsky, 2006). To gain such benefits, the barriers to integrating and adopting Information and Communication Technology (ICT) in relation to learning environments, particularly the formal context of secondary education classrooms, have been researched for over three decades (Cilesiz, 2008; Ertmer et al., 2012; Ertmer, 1999; Hew & Brush, 2006).

This section presents a review of the barriers to ICT integration and adoption in the field of educational technology, specifically in the context of rural Bangladeshi schools. First, we find it necessary to reflect on the fact that our aim to empower local stakeholders through participation may be corrupted by building on prior studies. We cannot know for sure whether the problems found in other studies are the problems experienced by the present stakeholders. Also, we cannot know that the solutions found in others studies will be helpful to the present stakeholders. We risk bringing too much knowledge and thus being unable to engage in a participatory learning process – why listen when we know so much already? The reality, however, is that from various studies, some of them our own, we do know quite a lot about the potential problems, barriers, and solutions. This knowledge has led us to believe that local participation and empowerment are crucial to development, and we build on this same knowledge in preparation for action aimed at participation and empowerment.

To review the barriers, the point of departure is taken from a framework of barriers (see Figure 1) developed by Khalid and Nyvang (2013a). The framework establishes the fact that the barriers are situated based on the policies, procedures, and practices of the education systems' national-level organizations; the educational institutions; the individual stakeholders; and the external environment. This framework builds on the existence and non-existence of power-relationships within all levels of the education system and the external environment.

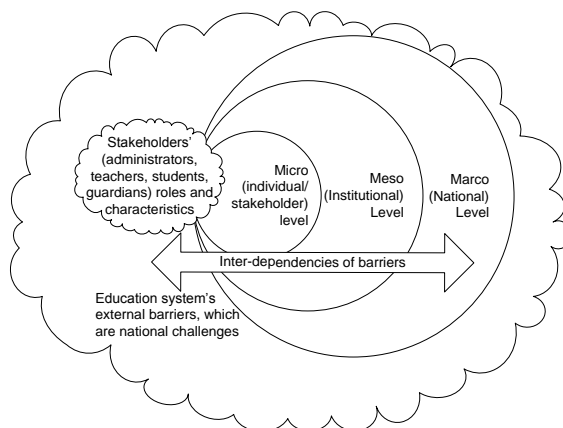


Figure 1. Framework of Barriers in Educational Technology Integration and Adoption,
Source: (Khalid & Nyvang, 2013a)

Hew and Brush (2006) and Rogers (2000) categorize the barriers into broad categories as follows: (a) resources, (b) knowledge and skills, (c) institutions, (d) attitudes and beliefs, (e) assessment, (f) subject culture, and (g) funding. The participatory research of Khalid and Nyvang (2013a) demonstrates that the causes of each of the barriers within each category are usually at play in relation to multiple others; the same barrier can be dependent on multiple levels of the education system's adoption decision, as well as factors external to the institutions and education system. Across all levels of the education system, there is a lack of resources that includes funding, ownership of technology, access to technology, time, technical support, teachers and trainers, and the low quality of resources (An & Reigeluth, 2011; Khan et al., 2012; Wachira & Keengwe, 2010). The lack of knowledge and skills may relate to technology, technology-supported pedagogy, or technology-related classroom management (An & Reigeluth, 2011; Khan et al., 2012; Wachira & Keengwe, 2010). Some of the institution-level barriers are the lack of leadership and decision support, classroom environment and design, collaboration culture among teachers, institute-wide instructional vision,

school time-tabling structure, planning, and ICT policy and procedures (Tondeur, van Keer, van Braak, & Valcke, 2008; Wachira & Keengwe, 2010; Ward & Parr, 2011) (Means, 2010). Attitudes and beliefs are individual-level resistances to change regarding teaching, learning, and technology (Ertmer et al., 2012; Pierce & Ball, 2009; Tondeur et al., 2008; Wachira & Keengwe, 2010). Barriers can be caused by both the levels of the education system and external forces, involving pressure to meet higher standards, obtain high scores on state tests, and cover vast material requirements, as well as the nonconformance of technology integration with the external requirements of traditional exams (Ertmer et al., 2012; Wachira & Keengwe, 2010). External barriers include the lack of electricity, networks, and communication infrastructure; gender roles and differences; differences between the mother tongue and the language of the ICT interface; low English proficiency; workload in terms of domestic chores; low average educational attainment; political unrest; and corruption (Khan et al., 2012; Sharma, 2003).

The Bangladeshi context of educational technology integration and adoption in classrooms, particularly in the rural areas, is prone to greater incidences of certain barriers (Abdullah-Al-Mamun, 2012; Khalid & Nyvang, 2013; Khan et al., 2012). For instance, only 47% of the power supply comes from the national grid, 37.73% of which goes to rural areas (BPDB, 2009), where 76.90% of the population lives (BBS, 2010) and more than 80% of the secondary educational institutions are situated (BANBEIS, 2010). Only 55.41% of villages (of 68038) are electrified (REB, 2012). Moreover, the inability to purchase technologies, lack of maintenance facilities, lack of teacher training, fear of handling the expensive ICT equipment, poor transport communication systems, poor English language skills of both teachers and students, and inability to operate computers all pose problems (Khalid & Nyvang, 2013a). All types of secondary educational institutions in Bangladesh lack the basic minimum requirements for quality education. The issues are as follows: the lack of lesson plans, inability to complete the syllabus over the class duration, teachers with insufficient skills in delivering learning content, inability to retain student attention in class, low attendance, insufficient number of teachers, high student-teacher ratio, challenges in visualizing mathematics and science lessons, and decreasing interest in science subjects (Banks, 2009). Therefore, the facilitation of the integration and adoption of ICT in schools in Bangladesh involves great complexity and requires a deep understanding of the context, which can be achieved via the participation of both the researcher/agent and the schools' stakeholders.

Belland (2009) suggests that teachers' attitudes and barriers are rooted in their elementary educational experiences and calls for customized facilitation based on analyses of individual backgrounds and the grouping of individuals of similar backgrounds. This provides a direction for fundamentally rethinking change agents' facilitation process. In developing such a process, the individual stakeholders of an institution can be involved in the analysis of ICT practices in relation to education, and the barriers for both individuals and the institution can be identified and addressed. For example, 96% of Danish elementary schools have IT supervisors, whose role is to address adoption barriers and bridge the gaps between the education system and external systems through facilitating participation and the balance of power (Danmarks Evalueringsinstitut, 2009). Thus, in the development context of Bangladesh, this research integrates approaches from ethnographic, participatory, and action research.

3. Local Context

The land area of Denmark (43,094 sq km) is less than one-third of Bangladesh. On the contrary, the population of Bangladesh (142.3 millions) is more than 25 times greater than the population of Denmark (5.3 millions)(CIA, 2012). About 72% of the inhabitants in Bangladesh live in rural areas (World Bank, 2012). The current human development index (HDI), a composite measure of health, education and income, ranks Bangladesh 146 out of 187 countries. Per Capita income (GNI) in 2009-10 was 751USD. The literacy rate (7+) is among males 59.6% (2009) and among females 53.8% (2009) (Bangladesh Bureau of Statistics, 2011). The adult literacy rate (15+) is among males is 62.6% (2009) and among females 54.3% (2009). Judged from these numbers alone Bangladesh in general and rural areas in particular faces severe challenges, but we have restricted our focus to that of education.

Bangladesh has three different education stems, i.e. General, Madrassa (Islamic), and Technical and vocational institutions. Among these, to get accredited by the education board, only technical and vocational institutes are required to have at least one computer lab and a computer teacher. Until 2011, only the TVET curriculum had a compulsory subject on computer from ninth grade to twelfth. In addition, for populous-rural-Bangladesh, TVET is a prospective system for human resource development, poverty alleviation, rural development and "education for all" achievement (Basu & Majumdar, 2009).The present study was situated in Tofail Ali Technical School and College (TTSC) — a rural private technical and vocational institution (with 325 students and 17 teachers) where the principal researcher formerly (in 2009) facilitated voluntary

ICT training and was well-acquainted with the founder and management committee. Therefore, the selection was convenient in terms of reducing uncertainties in relation to the time required to establish relationships in a foreign land. In December of 2010, TTSC authorities approved the principal researcher's request to take on the role of researcher and facilitator of ICT adoption in the institution. Then, as part of the facilitation process, the authors assured funding for TTSC to partner with a national pilot project that mobilized resources and training. The principle researcher was accepted as a consultant for the pilot project of the implementer NGO, which was named the Development Research Network (D.Net), for a period of three months. The principle researcher performed the role of "change agent" (E. M. Rogers, 1995, Chapter 9) and gained an insider's viewpoint (Chambers, 1994a, 1994b) from TTSC and D.Net. From the perspective of participation and power acceptance by the management and the fact that we brought resources most likely put us in a power position when collaborating with other stakeholders. We will return to that later.

In the process of transforming ICT practices in the classroom settings of TTSC, the principle researcher conducted two live-in field studies from August of 2011 to January of 2012 and from August 20, 2012 to September 29, 2012. Data were collected during these field studies. In addition, as part of the continuous facilitation of TTSC, significant numbers of discussions and conversations were held over mobile phone, email, messenger tools, and online chat.

3. Methodology and methods

This study is founded on a transformative research paradigm, which advocates participatory research, action research, mixed methods, and live-in field ethnographic experiences for bi-directional communication and sustainable change among both the researchers and the participants (Creswell, 2003; Mackenzie & Knipe, 2006; D. M. Mertens, 2007, 2010; Donna M. Mertens, 2010). To achieve this, this study applies the methodology of Ethnographic Action Research (EAR), which UNESCO recognizes as one of the best research approaches for working with ICT for sustainable development and studying the impact of ICT (Hartmann, Fischer, & Haymaker, 2009; J. A. Tacchi, Foth, & Hearn, 2009; J. A. Tacchi, Slater, & Hearn, 2003; J. Tacchi, Foth, & Hearn, 2007). It should be mentioned here that once more, we walk a thin line. We choose EAR in order to avoid a top-down approach to the research and change process in the school, but EAR is very much promoted as being top-down by UNESCO. EAR is, however, a rather loose framework for action research, so what matters most is how we choose to apply it in practice.

The EAR methodology combines two approaches: ethnography and action research. "Ethnography is a research approach that has traditionally been used to understand different cultures. Action research is used to bring about new activities through new understandings of situations" (Tacchi et al., 2003, p. 1). Thus, "Ethnography and participatory techniques are used to guide the research process and action research to link the research back in to the initiative through the development and planning of new activities" (Tacchi et al., 2009, p. 35). The empirical experiences from this research resulted in an adapted process for the EAR methodology, which is described by Tacchi et al. (2009, 2003; 2004). The adapted cyclical process in Figure 2 depicts the EAR phases as follows:

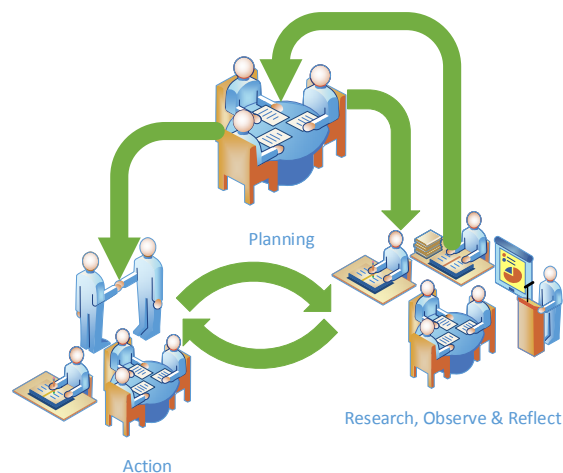


Figure 2. The Process of Ethnographic Action Research

- Planning: Planning of agenda and activities based on preliminary knowledge from literature and researchers' experiences in the context.
- Research, observe, and reflect (Participatory pre-analysis of practices): The use of participatory methods results in the identification of problems and revising the agenda for change.
- Action (Facilitation in action): The researchers and participants facilitate one another through agenda-oriented, problem-based actions and interactions.
- Research, observe, and reflect (Participatory post-analysis of actions for change): The use of participatory methods and the action and interaction experiences contribute to an analysis of an informal/formal inquiry into the agenda for research and the agenda for change. This post-analysis allows further change in the planning for action and research.

Based on a literature study (as partly represented in the previous section), previous facilitation experience in the researched institution, and consultation with the school's management, the principal researcher set out an agenda as follows: The school should have a practice of computer-supported instruction in the classrooms. The preliminary list of problems included funding, resources, and knowledge and skills. This agenda for transformation from a chalk-and-talk classroom and the related initial barriers to change triggered the action phase. In addition, Rogers' (1995) theory of the diffusion of innovations was considered as a guideline for the change agent's role (1995, Chapter 9) and change processes at the individual level (1995, Chapter 5) and the organizational level (1995, Chapter 10).

The field researcher experienced that the role and power of each participant depend on the context, in which individual-level and organizational-level beliefs and practices mutually determine the agenda and actions for change. Thus, except for the broader goal of the initiative, continuous changes occurred in each of the iterations of planning and working towards addressing the barriers. More implicit issues became explicit and were recognized, leading to an uptake of actions to address those issues. Thus, this EAR process has enabled the change agent to facilitate sustainable scaffolding. Leydesdorff's (2003) analysis of actions and interactions indicates that the complex mix of participation, observation, and analysis among the clients and agents in an EAR process has a great ability to explain how perceptions are changed. Thus, because individual-level changes in perception are outside the scope this paper, the focus is on the phases of facilitation, the barriers addressed at each stage, and the methods.

Methods

The EAR includes Participatory Action Research (PAR) and uses the methods and triangulation principles of PAR (Tacchi et al., 2009). Moreover, PAR methods are well-established within Participatory Rural Appraisal (PRA) and are also recognized as Participatory Learning and Action (PLA) methods (Chambers, 2008; Narayanasamy, 2009). Thus, as part of the EAR, this research exercised PRA methods and principles. Essentially, the methods used were a series of workshops, Focus Group Discussions (FGDs), Semi-Structured Interviews (SSIs), and participant and non-participant observations by the management, teachers, staff, and students. Concerning these participants, the methodical application of PRA-based research and the findings regarding the barriers are elaborated by Khalid and Nyvang (2013a). In addition, the D.Net team partnership participated in a six-hour workshop on Wednesday, September 28, 2011 after the first support and monitoring visits to all 30 institutes where resources and training were mobilized. Moreover, the very situated and participative role of the change agent in collaborating with the various stakeholders in terms of services and resources involved a large number of face-to-face, mobile phone, and internet-based communications. These actions and interactions contributed to the objective of creating a sustainable scaffolding through methodical plurality and involved complex and detailed forms of participation and power: the assessment workshop with the multimedia content development company, email and mobile conversations with the mobile-Internet service provider's customer service and system analysis departments, and coordinating the mobilization and installation of resources from D.Net in TTSC. Thus, these actions and interactions intended to aid in problem-solving facilitation also contributed in the form of research data gathered through a plurality of methods that are inherently complex, difficult to put into methodical order for analysis, and could be labeled participant observation. Thus, triangulating among PRA techniques (including FGDs, participant and non-participant observations, and SSIs), workshops, field notes, and other forms of self-documentation (e.g., documents, reports, audio, and video) following the analysis of the EAR experience presents a holistic process of facilitation for a period of more than two years.

4. The EAR Process

This section reports from the EAR process one overall theme for four iterations: 1. Planning and preparation, 2. First field experience, 3. Many challenges, and 4. Organizational change.

Iteration 1: Planning and Preparation

The agenda for this EAR was to identify the barriers to integrating and adopting ICT in a rural secondary educational institution and to adopt strategies to circumvent or overcome these barriers. The point of departure for applying the EAR was taken from the authors' former experiences in the field of educational technology, the barriers identified in the literature on various learning contexts, and former experiences with the barriers in the context of TTSC. The agenda was discussed with the members of TTSC's management committee (the founder, chairman, and principal) over mobile phone, and the high-priority barriers were identified as follows: TTSC's lack of funding; ownership of computers for instructional activities; access to computers for classroom activities other than labs; classroom infrastructure; and knowledge and skills in relation to technology, pedagogy, and administration, as well as the national electricity crisis. Thus, the principal researcher was accepted as a consultant, and two field studies were planned to facilitate the required knowledge and skills. In addition, possible ways of arranging for funding and prospective resource mobilization designs were examined. The consultant was given a significant level of power and trust to bridge the gap between the employees and the management. Two field studies were planned, reserving about six months for the first and about two months for the second.

The lack of funding for computers and supporting technologies was dealt with first. The local organization D.Net called for private sponsors for a computer literacy program (CLP) (CLP, 2012). The sponsorship fund was granted by the C.W. Obel Family Foundation, and additional resources and funding for the first field study were granted by Aalborg University. The CLP involved establishing a Smart Classroom (SCR) to be used as a formal classroom and a Computer Literacy Center (CLC) to be used as a non-formal training center. The SCR implementation involved the following resources: a 32-inch LCD TV for mounting on the wall beside the backboard or whiteboard, a laptop with extended battery capacity to be connected to the TV, a four-panel hybrid solar control panel system with an AC input to backup up to 200 watts through two batteries, a flash drive, and a one-year maintenance contract. In addition, two and half days of training on computer use and teaching with a multimedia CD and selected lessons for classes VI to X for teachers of English, mathematics, science, and geography were included, as well as a Computer Teaches Every English (CTEE) multimedia CD, a teacher's manual, guidelines on class-routine restructuring, a printed lesson plan, and a book titled *Esho Computer Shikhi* (Let us learn computer) for teachers. These resources also had the potential to address the electricity issue via the use of the hybrid solar power backup system that could be recharged via both AC inputs and four solar panels; laptops with longer battery lives, as opposed to traditional desktops with expensive backup systems; an LCD TV that could be used for educational TV programs and multimedia content for the class and whose power backup requirements were significantly lower than multimedia projectors; and preliminary training for teachers. Furthermore, the selected subjects were those for which there was a low rate of passing on the state tests: English, mathematics, and science. For instance, in 2010, more than 26% of students failed the junior school/Dakhil certificate (JSC/JDC) exams, and most failed English, mathematics and science (Habib & Nobin, 2010).

The CLP project required the prospective institutes to ensure the allocation of one classroom with traditional resources and provide for installing the SCR resources. Thus, the allocation of resources allowed the participation and power needed for demanding agenda-oriented efforts for each of the stakeholder entities: the CLP project, the sponsor (researchers), and the institution. Thus, the authors decided to sponsor TTSC to gain additional insight into the CLP project's barriers and at the same time take advantage of the facilitation with resources and training. This was, however, not done without hesitation. By implementing the SCR resources before the local stakeholders had much opportunity to consider whether this was a sound and sustainable solution, we took upon us the power to define what solution would best fit the school.

TTSC allocated one room for SCR in an under-construction tin-shed structure with cement walls and floors. Four teachers received training in a traditional computer lab environment regarding how to use computers and operate multimedia CDs, as well as regarding the concept of SCR, and received books and other materials for self-paced exploration.

Iteration 2: First Field Experience

During the first field study, by the end of September of 2011, both action and research were conducted and complemented one another. The PRA methods explored (a significant proportion of) the barriers in relation to informal practices (Khalid, Nyvang, & Islam, 2013) and the formal TVET curriculum (Khalid & Nyvang, 2013a). In addition, significant numbers of discussions and interviews were conducted, and workshops on three themes were initiated as actions for problem solving, decision making, and participatory analyses for research. First, a workshop with selected teachers and student volunteers was conducted to redesign a classroom and make formal decisions about organizational actions. Second, workshops with teachers about integrating SCR resources into instructional practices involved preparing a year-long lesson plan by subject, an assessment plan, the evaluation of multimedia content via state assessment factors, and a formal class intended to understand the barriers teachers face, the troubleshoot experiences teachers go through and gather student feedback. Third, teachers were engaged in evening planning workshops to discuss formal committees that were involved in various organizational decisions, policies, and procedures. These workshops were initiated and scheduled until the end of the second field study in response to facilitation requirements but were not pre-planned as part of the project's strategic plan. These workshops, involving administrative meetings, training, design, and experimentation, required additional time from the already-overworked teachers, who were motivated or otherwise inspired due the field researcher's participation and power relationships. These workshops were considered to be opportunities for effective change and a support service, which is otherwise not present in the area. Organizing such an in situ workshop required less effort for the change agent, reduced dislocation expenses, and offered great convenience for the female teachers.

During the first visit to the SCR, it was found that the devices were never fully installed for testing; both the TV and laptop remained packed and secured. However, there was a provision to hang the TV on the wall using two custom-made iron bars. Moreover, the way to connect the devices was not known to anyone, the solar control panel came without a manual, the AC-power connection cable was found to be without a two-pin plug, and the wire was coiled and secured with a high-hanging rope.

Prompt facilitation by the field researcher was possible for having sponsored the institution, the role of visiting scholar at D.Net and the role of consultant at TTSC; these roles gave the scope to participate as an agent for one another. In particular, knowing the appropriate resource persons, as well as their power, ability to provide support, access to information, and decision-making abilities, was the key to overcoming certain barriers and identifying other underlying barriers. The authoritative approach of the field researcher, along with the power of the sponsor, helped to verify that the reasons for the equipment being incomplete were as follows: The SCR was under construction when the vendor arrived to install the solar power system. He or she found that the plaster and painting had not been completed. The teachers, particularly the electrical trade instructor, reasoned that the system components were new, that neither training nor a manual was provided regarding these, and that the equipment was expensive and should not be experimented with. Due to the busy schedule of the vendor, support involved a waiting period of more than four weeks due to TTSC's disadvantaged location in terms of communications. Thus, the field researcher facilitated some teachers in installing the resources and testing that all of the equipment functioned. During the first test run, there was a need for a loudspeaker under the tin roof because of the drizzling raindrop sound, so, later, a sound system was purchased for the SCR.



Figure 3. Hybrid Solar Power System for SCR power backup

During a short-notice workshop, the principal, three teachers, and some students of grades X-XII redesigned the SCR with the facilitation of the field researcher. A six-day experiment with trial classes showed that at least 16 hours of uninterrupted classes could be conducted with the hybrid power backup in the absence of an AC power supply under a partly cloudy September sky. Additionally, each connected device gave a small shock, which could not be understood or fixed, even by the support engineer. The problem remained unresolved. Moreover, as the vendor could not provide documentation for the hybrid solar system, an outline was prepared with hand-written notes (redrawn in Figure 4). Excessive mud, dust, and chalk on the TV and laptop screens increased the possibility of high maintenance requirements. Thus, giving the TV a cotton-cloth cover was suggested. Additional suggestions were to replace the blackboard with a whiteboard and place the whiteboard in the middle of the class, keeping the lecture dais with the laptop on one side and the TV on the other (see Figure 5 and 6). All three must be at around the same height. The data cable behind the TV was pressed against the wall, and protective cushioning elements were used to prevent it from becoming damaged. This flaw in the design of the tools in terms of hanging remained unresolved.

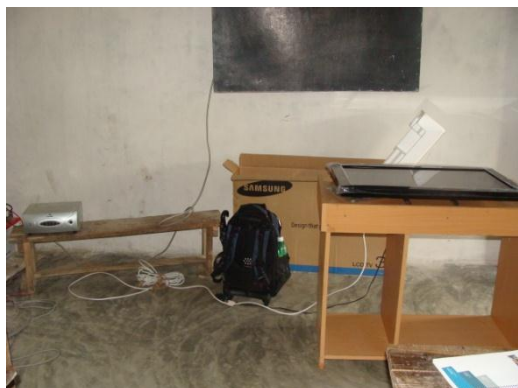


Figure 4. SCR setup in progress



Figure 5. Experimental class in redesigned SCR

Iteration 3: Many Challenges

In the planning meeting, the teachers decided that the SCR could not be formally used in 2011. The reason for this was that the teachers would be busy preparing for the Junior School Certification (JSC) examination for the TTSC Junior School in October and for final examinations in November. The teachers would not have sufficient time to practice the technologies, map the project-provided content with a lesson plan, plan the activities for each class, and schedule a new routine. Most importantly, TTSC has around a 50% teacher vacancy rate, and current teachers are also working for the to-be-approved junior school (VI-VIII). Moreover, the SCR must be accessed by both mathematics and English teachers and by both grades IX and X. This involves complexities in preparing the routine and must involve the academic committee of the school.

At the time, we would have liked for the project to proceed faster, but in hindsight, we can see that the teachers maintained power over school planning rather than handing it over to the change agent merely because he sponsored the SCR, appeared to an expert, etc. We were, however, not the only ones experiencing severe challenges. The field researcher attended a D.Net workshop with a D.Net team on September 27, 2011. The workshop involved analyses of the findings from the team's visit to 30 schools involved in the same kind of development project.

One of the aims of the D.Net development program was to achieve contributory participation and a balance of power. The sponsor-motivated and school-inspired expression of interest involved a participatory approach to expressing the need to adopt ICT. However, despite dedicated efforts, the project continued to strongly depend on stakeholders. Diverse and unforeseen barriers, including multi-level barriers to the integration and adoption of ICT in the education system, remained. One such challenge was the fact that neither TTSC nor TTSC-JS could not begin to plan for routinizing until the next year's routine planning. Again, the school planners maintained power during the process. The SCR resources were received by the institutions in an unplanned order and from different vendors, i.e., the solar hybrid system, LCD TV, and laptop reached the institutions at different times, which was "fine" for some but was "not easy" during setup. Some institutions could not use their solar backup systems, claiming that the teachers and staff did not receive training on how to use the system, that the control panel did not come with a system diagram or control panel manual, and that they did not receive support from the solar power system setup vendor, despite

notifying him or her of the necessity of this over mobile phone. It was observed that the institutions did not observe the recommended distance from the floor or side wall when hanging the TV. Having the liberty to set it up on their own caused the school inconvenience in conducting classes. A few institutions did not have earth phase and thunderbolt protection to prevent shocks and surges. Security and trust were the main barriers to allowing convenient access, and some schools made special wall-mounted protective shelves for locking after use. The fact that operators lacked strong skills caused the discontinuation of the use of some SCR technologies. Institutions with multiple sections for each class required criteria that could be used to determine the allocation of the sole SCR. Some teachers informed the headmaster that they would not teach using the SCR anyway, while others showed a strong interest in doing so but requested additional training because they were very weak in computer use. The type of support that was most frequently asked for was prompt on-demand support. Some feedback was related to the improvement of the CD contents and interface. Some teachers were under the impression that all the lessons would be found on the multimedia CD and that classes should be focused on how to increase ICT-mediated activities. However, the teacher training had conveyed the fact that the multimedia contents would only cover prioritized and visually complex topics, which would not exceed one-third of the full text syllabus. Based on the findings, refresher training, an SCR setup manual, an improved teacher guide, a training manual and training guide, and longer on-site training and visits were prioritized by GPIE for the next two years.

After returning to the village, a series of workshops were held to analyze the existing instruction and assessment practices and integrate the SCR into the lesson plan. It was found that none of the subjects were taught using a formal lesson plan. For TTSC teachers, conducting a class included textbooks, guidebooks, and blackboard. However, when integrating the SCR, it was essential to plan each activity in the class. Thus, focus group discussions with the teachers resulted in deciding to use a guidebook, multimedia content, and the blackboard. So, without altering their existing practice of the use of resources it was decided to consider textbooks to refer to chapter and sections. Thus, to integrate the SCR, both teachers of mathematics and English were instructed by the principal to prepare one year's lesson plan for one class (IX or X) in their own way. Moreover, other teachers were facilitated in preparing an outline of activities for a preferred subject. An official deadline was set for submitting the plan to the principal's office, and the principal demonstrated his outline of a lesson plan for motivating the teachers. To identify students' attitudes, a tenth-grade mathematics class was conducted by the field researcher. The students reported that the content was interesting, easy to visualize, and easy to follow, in addition to covering more content in a shorter time and including more examples. A test class was conducted by the subject teacher, and the students commented that pronunciation and attentiveness might be improved because of the audio. However, the sound of the rain on the tin roof was distracting.

Iteration 4: Organizational Change

During the planning workshops in December of 2011 and January of 2012, decisions were made in relation to funding for ICT issues, leadership, operations and maintenance expenses, the employment of an ad-hoc computer teacher cum support staff member, the roles and resources of an ICT committee, a separate account for this ICT committee, the fact that the class routine preparation would be a collaboration between the academic committee and the ICT committee, the fact that English and mathematics for the ninth and tenth grades would be held in the SCR, and the fact that Tofail Ali Kindergarten's (TAKG) primary-level students would be able to access the SCR. These decisions addressed the lack of leadership regarding ensuring access, maintenance, support requirements, and facilitation by a computer teacher in relation to the computer labs, the SCR, and CLC resources. Because one lecturer position, two trade instructor positions, and one demonstrator cum mechanic for the computer subjects and labs position remained vacant, even in early 2013, there had been no fund for the operations and maintenance of the ICT equipment.

The proposal for the ICT committee and the routine, along with the integration of the SCR, was approved by the core decision authorities, the founder and the chairman. However, the separate account for the ICT committee was approved much later, after trying out potential contribution in administrative function, local administrators' autonomy and financial sustainability (cf. Khalid & Nyvang, 2013b). The field researcher had trained one TTSC alumnus, who was appointed to be a teacher cum mechanic. This new role, as part of the ICT committee, was assigned the responsibility of maintaining the SCR, CLC, lab classes, and other computer classes. The salary for the job was allocated from the project fund. At the end of the first field study, the mathematics teacher suffered a motorbike accident, and healing the resultant broken leg took more than three months. The fact that this same teacher was responsible for teaching science was a great loss to TTSC and TTSC-JS, including the further integration of the SCR. Until the second field study began, the SCR was used sparingly, and during the rainy season, some seating was broken. Regular classes had to take

the furniture from the SCR. Furthermore, the English teacher moved away from TTSC, and the SCR adoption in English classes was not sustained.

During the FGDs in the second field study, students from the ninth and tenth grades expressed overwhelming excitement regarding the experience of attending the SCR. However, teachers experienced major challenges. The regular use of the SCR required moving the students to the SCR, accessing the SCR at the exact scheduled period, turning on the devices, preparing the contents for access, proficiency in both the technologies and contents, and sufficient time to turn everything off if another class would not be occupying the classroom immediately. More barriers were identified as follows: lack of time between periods, the fact that access to the SCR depended on the availability and prompt support of a support staff member, teachers needing a copy of the SCR key, the cost associated with such liberal access, the fact that whiteboards must be wiped before leaving class or sand and dust would stick to the board, causing marks on the whiteboard and decreasing duster longevity, etc. The field researcher arranged an external fund from Bangladeshi sources, and seating arrangements for the SCR were ensured. Once again, workshops for SCR lessons plans were conducted, newly appointed teachers went through the learning process as others had, and other teachers improvised lesson plans based on their prior experiences. Although the integration of ICT with the lesson plan was not identified as a major challenge, the adoption of the ICT-enabled instructions in the routine activities of institutional practices was hampered by some major barriers: lack of teachers, lack of time, ease of access to the SCR, lack of trust, and high maintenance due to rural environmental factors.

During the end of the second field study, the teachers, students, founder, and field researcher evaluated the experience through role-based and collective FGDs. From the FGDs, it can be said that both TTSC and TTSC-JS went through certain sustainable changes as a result of facilitation in situ, the freedom to participate and express requirements, dedication to contributing towards the goal, and the facilitation of the balance of power between the provider and the receiver of information, decisions, and services.

5. Findings

We set out to research how a researcher and change agent by means of a participatory process can construct and distribute knowledge together with local stakeholders so that the local stakeholders ultimately can take charge of a continued development. That aim implied an interest in participatory knowledge processes, but the words take charge also implied that we are dealing with the distribution of power to and among the local stakeholders. It appears that we succeeded in bringing home more knowledge about collaborative processes in a rural Bangladeshi setting, which we will return to shortly, but did we succeed in empowering the local stakeholders through participatory processes towards a sustainable use of in the institution? The short answer would be no, since we cannot know for sure yet if the change has been sustainable. A more complex answer is that we did manage to involve the local stakeholders; management, teachers and students were part of and influenced the process and it appears that all parties developed new knowledge with regards to the use of ICT in the process. Again, to add a critical voice, we cannot say for sure that sufficient knowledge to make the project sustainable was created. In a similar critical voice we cannot claim and document that those teachers who experienced that some of the existing teaching skills started to become obsolete with the introduction of ICT had the old knowledge sufficiently replaced with new knowledge. If they didn't have the old knowledge sufficiently replaced it is a treat to the sustainability of the change project.

In terms of the power issues, the local stakeholders did, on the surface, maintain power. The management was still in charge of the institution and teachers were still in charge of classes. Students were still only sparsely involved in decisions. In that respect the distribution of power was not changed. But we also see signs that the process we initiated also stirred up the distribution of power. The field researcher was granted power to conduct research, to carry out experiments and to bring in new technology. The field researcher was well connected with the management, brought funds and knowledge and by doing so he had the power to influence many processes in the school. The project also led to some of the teachers being told by management to plan classes differently as a consequence of the work done by the field researcher. The student helper that took the role of assistant to the field researcher because he knew much about ICT probably challenged some of the existing power relations because he knew more about ICT than the teachers and because he was so closely associated with the powerful field researcher.

The trust issues we have mentioned more times cut across the knowledge and power themes. Lack of trust (and self-confidence on the part of the teachers) keeps teachers from experimenting with ICT and keeps students from being allowed to play with the technology. The equipment was not properly installed in the first place – most likely because staff was afraid to break something and properly also because they did not believe to have been formerly allowed to do so.

What we have learned about changing institutions in rural Bangladesh, despite the critical comments, is that a collaborative process still appears promising. A change agent bringing new knowledge can facilitate that management; teachers and students can develop an understanding of the local potential in ICT. A change agent must, however, spent much time in the institution over several years to continuously train all teachers until the institution itself has the knowledge and power to both train new teachers and further develop the institution.

With respect to doing research in rural Bangladesh we have also learned that an action oriented approach is promising. Had we opted for a traditional ethnographic approach we would probably still have been waiting for anything really interesting to happen with respect to our interest in educational technology. We had never seen boxes of equipment arrive without being opened and used and we had never experienced the rest of the many practical problems in relation to using ICT in the specific setting just to mention two examples. We also believe to have seen the multi-level problems and barriers to ICT more clearly because we saw them enacted instead of only foreseeing them by analyzing existing practice. And finally, we clearly saw that changing an institution like the one we have worked with is not only about funding. It is very much about supplying and building a local knowledge base.

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Paper VII

A Change Agent's Facilitation Process for Overcoming the Barriers of ICT Adoption for Educational Administration – A Case of Rural-Bangladesh Vocational Institution

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A change agent's facilitation process for overcoming the barriers of ICT adoption for educational administration – A case of rural-Bangladesh vocational institution

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The factors influencing the use of ICT as a professional and management tool outside the classroom have received little research attention. So the two objectives were: how do stakeholders of educational administration experience the barriers of ICT adoption and how can they facilitate the transformation process in addressing the barriers that prevent the adoption? Taking a case from the development context of rural Bangladesh, the investigation is based on three theoretical stances: educational administration, the diffusion of innovations, and Participatory Rural Appraisal (PRA). Field-study based change agent facilitation applied PRA as a two-way diffusion communication method. The study concludes that barriers originate from the levels of individuals, the educational institution, the national agencies, and the external environment. PRA provided a useful framework facilitating communication to highlight barriers and gain a deeper understanding of what exactly the barriers at different levels are in a specific institution and how they influence practice.

Keywords: Educational administration: Adoption of ICT: Diffusion of Innovation: Change Agent: TVET: Digital Bangladesh: ICT4D: Rural Bangladesh.

Introduction

Research on educational technology has explored the barriers of integration and adoption of information and communication technologies (ICT) in teaching and learning activities (Balanskat, Blamire, & Kefala, 2006; Bingimlas, 2009; Chan, 2011; Ertmer, Ottenbreit-Leftwich, Sadik, Sendurur, & Sendurur, 2012; Ertmer, 2005; Hew & Brush, 2006; Looi, So, Toh, & Chen, 2011; Snoeyink & Ertmer, 2001). The barriers are classified in various ways: classroom or individual (micro-), school (meso-) and national (macro-) level barriers (Lim, 2006; Younie, 2006); teachers' internal and external barriers (Ertmer et al., 2012; Ertmer, 2005; Snoeyink & Ertmer, 2001); direct and indirect barriers (Hew & Brush, 2006); material and non-material barriers (Pelgrum, 2001) etc. Hew and Brush (2006) found the barriers to be related to:

- A lack of resources (i.e. technology, access to available technology time or person people, and technical support),
- knowledge and skills (on technology, technology-supported pedagogy, and technology-related classroom management),
- institution (including leadership, school time-tabling structure, and school planning),
- attitudes and beliefs (about teaching and learning and about technology),
- assessment (involving pressure to meet higher standards and high scores in state tests, meet vast material requirements, conformance of technology integration with external requirements of traditional exams),
- subject culture (shaped by content, pedagogy, and subject assessment) – both from the perspectives of the stakeholders and organizations of the education system.

In addition, government policy on ICT in education faces implementation problems of management, funding, technology procurement, ICT training and impact on pedagogy (Younie, 2006).

“While most studies primarily focus on the use of ICT in teaching and learning, little attention has been given to their incorporation as a professional tool outside the classroom” (Meneses, Fàbregues, Rodríguez-Gómez, & Ion, 2012, p. 915). Based on a review of literature, the professional use of ICT can be categorized into two types: firstly, supportive use including preparation activities for the classroom; and secondly, *management* use, referring to “teachers’ general duties in the functioning of schools as organizations” (Meneses et al., 2012). The management use encompasses the conduct of management and

administrative tasks (Prokopiadou, 2012; Saiti & Prokopiadou, 2009), communication with experts and colleagues (Law, Pelgrum, Plomp, & International Association for the Evaluation of Educational Achievement, 2008), and interaction with students and parents (Ward & Parr, 2010). This study deals with the adoption of ICT in management and administrative tasks. In particular, the research case explores a secondary institution's administration challenges in adopting the web-based tools and accessing the online information of a national education board. Such an adoption process involves the transformation of the educational administration system of the organization.

The educational technology literature lacks a theoretically established definition of 'educational administration'. In addition, there is scarce account of empirical findings on the ICT adoption barriers faced by the rural educational institutions of developing countries (Bingimlas, 2009; Hew & Brush, 2006). Moreover, former empirical investigations on ICT integration and adoption barriers relied solely on interviews and/or surveys and are lacking mixed-methods-based research (Hew & Brush, 2006; Mwalongo, 2011). Within this scope, this paper begins with a theoretically founded definition of educational administration and applies mixed-methods in order to address the following two context-dependent research questions. Firstly, how do the stakeholders of the educational administration of a rural secondary educational institution experience the ICT adoption barriers? Secondly, how to facilitate ICT adoption decisions and subsequent transformation process in a school?

This paper is divided into the following six sections. Firstly, the scope of the present paper is based on a theoretically founded definition of educational administration and a systematic review on ICT in educational administration. Secondly, the motivation for selecting and building on a situated single case in Bangladesh, particularly the selection of a rural, private, and technical vocational education and training (TVET) institution is discussed. Thirdly, the application of mixed methods, i.e., the participatory learning and action (PLA) methods and their validation processes are briefly presented along with an introduction to the case and the participants in the methods used. Fourthly, data are analyzed using a definition of educational administration and Rogers' (1995) theory of diffusion of innovations, focusing on the innovation process in an organization. Fifthly, the change agent (Rogers, 1995) role of the first author is analyzed in the context of organizational innovativeness (Rogers, 1995, p. 380). In conclusion, the findings are summarized and future scope is suggested.

Educational Administration

Definition of Educational Administration

Our definition of educational administration takes as its point of departure the open systems model (Lunenburg & Ornstein, 2012, pp. 20–21) that originated from the systems theory (Senge, 2006). The open systems model shares core components with Roger's diffusion theory — the change process, the interconnected components of a system and the focus on communication. This consideration, however, does not discard the resemblance and applicability of other definitions and models of educational administration.

The systems theory defines schools as learning organizations; the learning organization must be studied as a whole by taking into account the inter-relationships among its components and its relationship with the external environment (Senge, 2006). The open systems model presents a simple systems view of school administration (see Figure 1). It shows that a school is an open system of interactive components, including input, a transformation process, output, feedback, and the external environment. In addition, Figure 1 shows that the school's administrative roles, as part of a learning organization, are inter-related at multiple levels — at the levels of school, state agencies and external environment (Lim, 2006). This study explores the ways in which the ICT adoption barriers are rooted to the before mentioned components, and how the transformation process can be facilitated for addressing these barriers.

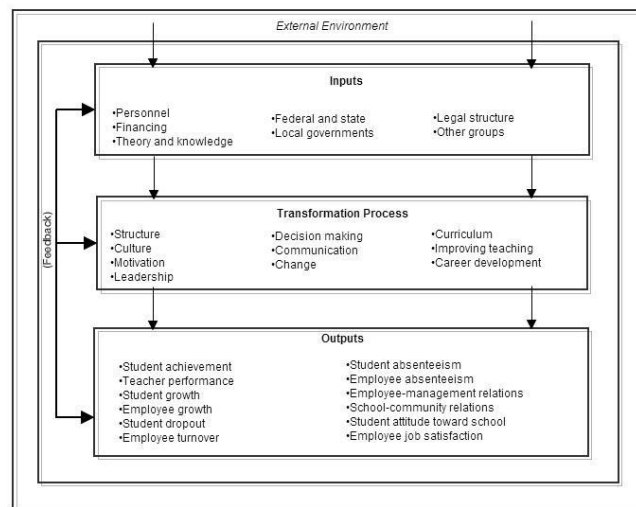


Figure 1. Systems view of school administration (Lunenburg & Ornstein, 2012)

To define the term organization and to understand the process of ICT adoption in the organization (see data analysis section), a second point of departure is taken from the theory of diffusion of innovations (Rogers, 1995). “An organization is a stable system of individuals who work together to achieve common goals through a hierarchy of ranks and a division of labor. Individual behavior in an organization is relatively stable and predictable because organizational structure is characterized by predetermined goals, prescribed roles, an authority structure, rules and regulations, and informal patterns” (Rogers, 1995, p. 403).

Having defined the educational administration as an open system and an organization we have also indicated that interconnected processes and levels are crucial to this study of barriers and ways to circumvent them.

Systematic review of literature

The extensive review reported in the introduction has provided an overview of the barriers to adoption of ICT in teaching and learning activities, categorized into micro-meso-macro level barriers, teachers’ internal and external barriers, direct and indirect barriers, and material and non-material barriers, etc. This review section adds within the administrative theme, specifically the management use of ICT for the general functioning of schools as organizations.

A systematic review was conducted using different combinations of the keywords “educational administration”, “school administration”, and “ICT adoption”. Searches returned peer-reviewed articles from ScienceDirect (797 articles), Scopus (5 articles), ProQuest (3125 articles), Google Scholar (17200 articles) and ERIC (456 articles), published during the year 2000 or later. First 500 titles and abstracts were considered from each of the databases. Only four empirical articles and one review article matched the scope of this study.

Firstly, Meneses et al. (2012) analyzed the relationship between Spanish primary and secondary level teachers’ attitudes towards, and professional uses of, the Internet. The study revealed that “even after controlling the effects of socio-demographics and school-level information, a school’s organizational development is related to more frequent professional uses among teaching staff”; there exists “a connection between daily organizational practices and the unequal appropriation of ICT outside the classroom”; “frequency of Internet access within and outside school has a similar effect on positive attitudes towards the professional use of ICT”, as the affordances of technologies are perceived over time; while within-school Internet access is associated with both types of professional use, outside school access is not associated with the management use of the Internet”; the location where the Internet is accessed plays a significant role in the types of teachers’ professional practices outside the classroom”;

“teachers who have attended useful-rated ICT courses, and especially those who reported a higher level of Internet mastering, show more positive attitudes and more frequent supportive and management uses” (Meneses et al., 2012, pp. 921–922).

Secondly, Saiti and Prokopiadou (2009) surveyed Greek secondary educators and analyzed the relationship between the adoption of ICT in school administration and different factors representing unfavourable environment. They found that the existing ICT of a school can serve administrative needs if technological equipment is located in the principal’s office, and if there is ICT equipment exclusively for administrative purposes. However, there is a strong negative effect if technical support is dependent on experts from a private company. Teachers’ familiarity with the use of computers for administrative purposes is positively associated with the following factors: the teacher is relatively young, the teacher is a male, the belief that a computer is important in administration, the teacher’s participation in relevant training program, and whether the school is located in an urban or semi-urban area.

Thirdly, Prokopiadou (2012) iterated a similar study on 230 Greek kindergarten principals and identified the following. The lack of technological equipment is caused by two things: poor management on the part of the Ministry of Education in the distribution of the available equipment to kindergartens, and limited financial support from the State. The educator’s knowledge and familiarity with computers is explained by the following main responses: the training program they had attended was inadequate, they were either approaching retirement or had not attended any relevant training program because there was no such program in their area, or they had applied to attend a training program but their application was not accepted by the service in charge. It investigated the dependency of *the degree of educators’ familiarity with computers* on: the age and the gender of the respondents; their perception of the importance of ICT to school administration; how frequently they used ICT for their administrative tasks; and whether or not the management of their administrative information was based on an information system” (Prokopiadou, 2012, p. 314). The result was that the young and the male educators are more likely to be more familiar with the use of computers. In addition, the presence of an administrative information system increases the likelihood of educators’ familiarity with computers.

Fourthly, Ranjit and Muniandi (2012) identified that lack of facilities, insufficient time to master and apply knowledge due to heavy teaching hours and attitudes of teachers are the barriers to technology adoption for Malaysian schools’ administration.

Fifthly, Ghavifekr, Afshari and Seger (2013) presented a conceptual review on the applications and effectiveness of ICT tools for school administration and management, as part of the 2020 Digital Malaysia initiatives. Various advantages experienced by the teachers’ and administrative staff’ regarding ICT mediated administrative activities were reviewed but the barriers and ways to circumvent the barriers remained unaddressed.

The review experience resulted in the identification of differences between the issues of the ICT adoption in the educational administration and in the teaching and learning activities. For instance, Prokopiadou (2012, p. 309) argued that “the difference between ICT in teaching-learning and in administration, in terms of professional training, may be noticed in the level of practical application, where the requisite skills and knowledge of relevant software applications differ according to the implementation domain, namely, teaching-learning or school administration”. The findings of these papers might be viewed as an initial exploration of the factors that affect the teachers and the administrative roles of educational institutions to use ICT as a professional tool in compulsory education (Meneses et al., 2012). Additionally, more studies are needed in order to explore the relationships and patterns that may explain changes. Moreover, more theoretical approaches need to be employed for exploring the organizational factors (Meneses et al., 2012). Furthermore, as most of the reviewed papers are survey-based and dependent on statistical significance, “a qualitative approach based on interviews and observations would extend our knowledge beyond statistical significance and general in-depth understanding about the meanings and values of the actors involved” (Meneses et al., 2012, p. 922). The reviewed literature also lacks a qualitative research that demonstrated a process to address the barriers by facilitating educational institutions. While the survey-based large-sample studies provide breadth, qualitative exploration from even a single-case study can provide depth (Flyvbjerg, 2006). So, current research builds on a long-term field based change agent facilitation to the educational administration stakeholders of one rural educational institution. Thus, this research attempts to contribute more depth about the ICT adoption

barriers, the nature of their relationships and the change agent experience. In addition, the case of this research is situated in a developing country and the research focuses on the transformation process in the institution.

Motivation behind the context selection

The motivation behind the context selection is discussed in two subsections. Firstly, international priorities in ICT in education and “Digital Bangladesh” focus on educational administration and Technical Vocational Education and Training (TVET). Secondly, the demand by the great number of institutions in need: rural, disadvantaged and private institutions in Bangladesh.

Digital Bangladesh: ICT in educational administration and TVET education

The case selection of the present research was motivated by the international priorities and Bangladesh’s national agenda on ICT in education and on TVET.

ICT in education is increasingly emphasized by the developing countries of the Asia Pacific region (Akhtar & Arinto, 2009). One example is “Vision 2021: Digital Bangladesh”, which sets out the agenda for “improving the education sector through ICT in education” (A2I: PMO, 2009; BOI: PMO, 2009). The Access to Information (A2I) project of the Prime Minister’s Office (PMO) of Bangladesh is responsible for coordinating the initiatives of this vision. The A2I project’s “Strategic Priorities of Digital Bangladesh: Improving Education Sector” had six focus areas for facilitating the adoption of ICT in education: General and TVET education systems, the professional development of teachers using ICT, education related citizen services, ICT literacy for students, ICT infrastructure and delivery channels, and ICT in the educational administration (A2I: PMO, 2009). In addition, it placed “special emphasis on TVET” (A2I: PMO, 2009). Moreover, the strategic themes and the action plans of the national ICT policy of the Bangladesh Government – 2009 (MoICT, 2009) explicitly mentioned the “education and research” objectives supporting the present case. Furthermore, 2005-2014 is the United Nations Decade of Education for Sustainable Development; TVET has been nominated as one of the key areas for a collective UNESCO effort (Hollander & Mar, 2009). The European Commission (EC) recognized its significance by providing financial support for the “TVET reform project” of Bangladesh (Mia, 2009).

Exploring the barriers in the context of Bangladesh was the central reason for situating the present study at a TVET institution. Bangladesh Technical Education Board (BTEB) was the first to integrate and to authoritatively decide that the TVET institutions have to use web-based systems for educational administration, starting from mid-2011. To the best of researcher’s knowledge, no research on ICT adoption for the educational administration of technical educational institutions of Bangladesh has been published.

Disadvantaged rural and private educational institutions

About 70% of the world’s poor population live in disadvantaged rural areas (World Bank, 2012), which deserve greater attention. Bangladesh has a population of about 142 million (BBS, 2011), and about 72% live in rural areas (World Bank, 2012). More than 91% (2730 of 2981) of TVE institutions of Bangladesh are private, accommodating about 80% of teachers and more than 70% of students in technical study programs (BANBEIS, 2012). In addition, more than 55% of the TVE institutions are located in the rural areas (BANBEIS, 2011). Therefore, a situated qualitative study on a TVE institution in Bangladesh could very well be situated in rural areas and be private sector.

Methodology

Research paradigm and methods

From our definition of educational administration and the literature review we have some general ideas what the barriers to ICT may be, but we aim for more qualitative and concrete insights into the nature of barriers. To reach such insights we chose to engage in the practice of changing an educational administration ourselves. We did so for three reasons: Firstly, personal engagement in a rural educational administration in Bangladesh was needed if we wanted to study a change process in such an

administration. Without intervention we had no change to study. Secondly, being part of the intervention the first author became part of the process rather than studying it from the outside which gave access to continuously interpret data, test interpretations, intervene and evaluate interventions. So, the first authors took the role of a change agent (Rogers, 1995), by living and working as consultants of a rural and private TVET institution in Bangladesh. Within action research design, two live-in field studies were conducted during August 2011- January 2012 and August-September 2012. Our third reason for an intervention based approach is in the words of the transformative paradigm that we “ [...] believe that inquiry needs to be intertwined with politics and a political agenda” (Creswell, 2003, p. 9), and the research should engage an action plan for change “that may change the lives of the participants, the institutions in which individuals work or live, and the researcher’s life” (Creswell, 2003, pp. 9–10).

The transformative paradigm also advocates a participatory approach and mixed methods for the development of “more complete and full portraits of our social world through the use of multiple perspectives and lenses” (Somekh & Lewin, 2005, p. 275) for exploring “greater diversity of values, stances and positions” (Somekh & Lewin, 2005, p. 275). The transformative paradigm does, however, not in itself prescribe how to intervene and how to collect data. We thus turned to methods and the principles from participatory learning and action (PLA), formerly known as Participatory Rural Appraisal (PRA) for our data collection (Chambers, 2008; Narayanasamy, 2009). The PRA methods were applied to gain from two-way diffusion communication between the stake holders of the TVET institution and the change agent. Through these methods, the parties facilitated each other in the understanding of innovation. The methods include focus group discussion (FGD), problem tree analysis (PTA), semi structured interview (SSI), and cultural transect.

The participants were: the founder, the management committee chairman, the principal, the consultant (the first author), one assistant professor (management), one lecturer (accounting), one assistant teacher (mathematics), one trade instructor (electrical), one part-time teacher (computer), one office assistant, and one MLSS (member of junior supporting staff). With the founder and the chairman, the change agent conducted unstructured and semi-structured interviews only. The analysis section discusses the process of selecting these participants.

The case

A typical rural private TVET institution was selected. Prior to the field research, the authors arranged a sponsorship for the institution to become part of a national public-private partnership program called computer literacy program (CLP, 2010). By June 2011, CLP provided resources for establishing a smart class room (SCR) and a computer literacy center (CLC). SCR included one 32-inch LCD TV, one laptop, a 200 watt hybrid solar system, one VGA cable, one audio cable, four trained teachers, and a one-year maintenance contract (CLP, 2011b). The CLC setup included 4 laptops, one laser printer, one EDGE modem, one flash drive, and the training of two teachers (CLP, 2011a). The objectives were to integrate and diffuse ICT through the use of SCR in classroom teaching and through the use of CLC in non-formal training to 8-student batches. At the beginning of the field study, in August 2011, the change agent (CA) and participants summarized the current condition of the lab as following: the only computer lab for the trade subject has five fully functioning desktops, one desktop and one printer are used from the principal’s room for all administrative activities, EDGE modems could not be connected to the Internet, the only office assistant with computer skills left recently, and 5 of 8 computer-skill positions were vacant. In addition, the existing three ICT teachers agreed that “without external help, on our own, it might not be possible to improve the situation”.

With the above-mentioned ICT resource condition at the client end, BTEB discontinued paper-based administrative activities with the TVET institutions in Bangladesh. Despite training from BTEB, the institution faced significant barriers and started hiring services from a nearby market for computer, internet and Xerox. Therefore, the present study analyzes the way in which ICT adoption in educational administration activities incidentally became an agenda and how the transformation process was facilitated by the present research initiative.

Analyzing innovation process and change agent facilitation

This section discusses the innovation adoption facilitation process based on the theory of the diffusion of innovations, namely the change agent facilitation and the steps of the innovation process in an organization (Rogers, 1995). “Data about the innovation process are obtained by synthesizing the recallable perceptions of key actors in the innovation process, written records of the organization adoption, and other data sources” (Rogers, 1995, p. 390). In the present paper, data about the innovation process includes the participants’ experiences (including the change agent) from the PRA methods, the recorded events, and the change agent’s recallable perceptions of events.

The analysis involves two theoretical foundations: a definition of educational administration and the theory of the diffusion of innovations. Based on the systems view of school administration (Figure 1) as part of the definition of educational administration, BTEB’s ICT-mediated administration initiative is considered as input that initiated the school’s administrative transformation process in decision making, communication, change and structure. The transformation process can be identified through Roger’s (Rogers, 1995, p. 392) five stages of the innovation adoption process in the organization. “The innovation process in an organization consists of two broad activities: (1) initiation, defined as all of the information gathering, as well as the conceptualizing, and planning for the adoption of an innovation, leading up to the decision to adopt, and (2) implementation, all of the events, actions, and decisions involved in implementing innovation. The initiation stage is further divided into 1. agenda-setting and 2. matching stages; implementation occurs over the three stages of redefining/restructuring, clarifying, and routinizing” (Rogers, 1995, p. 392). Therefore, the innovation adoption process and the change agent experiences are presented in five sections corresponding to each of the five innovation adoption stage.

Agenda-Setting: General organizational problems that may create a perceived need for innovation

The agenda-setting for the institution’s transformation process (see Figure 1) through ICT adoption for educational administration began from a mere informal discussion between the CA and the principal of the institution. The discussion has been translated from Bengali and transcribed into the following.

Principal: Brother, I am going to Majjara market. I have to finish the BTEB’s online registration forms by today and have them ready for their [BTEB’s] processing from tomorrow. ... So, I might not be meeting you before tomorrow and I wanted to say bye for today.

CA: But can we not do that here? As a TVET institution IT skills should be one of our core competences.

Principal: I guess, no. We can’t scan, edit images, or even get Internet connection. In fact, you might end up finding that our TVET institutions are mostly theoretical, getting away with memorization, and possibly provide rather frustrating levels of skills.

CA: Is that so! Anyway, I get Internet connection in my mobile. I can also access the Internet from my laptop by using both of my mobiles. Not that good, but it might be worth trying. I just felt that I might be able to get these things done, somehow.

Principal: Oh really! That sounds great. If you can find a way for us, it would surely save a lot of money, hassle, and time. But, we really have to finish that today.

CA: Please come inside the lab with me. Let’s try.

In brief, the subsequent events were as follows. In the absence of computer-skilled administrative personnel, the CA asked for assistance from a tenth grade student. The CA had identified the student to be exceptionally tech-savvy about the Internet and to possess strong skills as regards computer applications. The CA demonstrated the process to the student, the principal and the accounting lecturer. Scanning of passport-size photos of students was carried out using a mobile phone camera, and editing was done using the default image editor of the Windows operating system. Initially, the Internet was accessed through Wi-Fi hotspot of the CA’s mobile, until the charge depleted. Later, Internet connection was established by using the student’s mobile, until that too ran out of charge. Finally, due to the lack of power supply from the national grid, the EDGE modem from the CLP project was used with the CA’s SIM. The images were stored in a flash drive to ensure backup. By the time the entire process had been completed, the battery backups of two laptops were consumed before automatic shutdown. This process took more than 12 hours of uninterrupted effort for at least two persons at a time – among them the student, the principal, the CA, and the lecturer (accounting). The student dedicatedly completed the task without a break. The following

day, a three-person team attended a demonstration and experienced printing from the BTEB web-application. One copy was prepared to be sent to BTEB and the other was filed for the institution. Later, a staff meeting was scheduled for discussing the experience, and deciding about adoption of the before mentioned ICT based strategy and other administrative strategies and technologies within-institution, and prospective strategies for a sustainable change were outlined.

The above-mentioned events involved a creative mix of available technologies, available skills, and facilitated confidence-building. This might be viewed as part of the redefining stage, which involves modification of the innovation.

Agenda-setting is a continuous process in which “one or more individuals of an organization identify an important problem and then seek an innovation as one means of coping with the problem” (Rogers, 1995, p. 393). In the present case, the identified problem might be generalized as follows: the outsourcing of the ICT-mediated administrative activities of education-board-administered institutions involves higher cost, prolonged completion time, and the risk of misuse of authentication credentials, etc. The diffusion theory defines these problems as the performance gap which triggered the change.

Matching: Fitting a problem from the organization’s agenda with innovation

The matching stage “is a type of reality testing in which the members of an organization attempt to determine the feasibility of the innovation in solving the organization’s problem. Such symbolic planning entails consideration as to the anticipated problems that the innovation might encounter if it were implemented” (Rogers, 1995, p. 394). The institution’s identified problem was the performance gap in the outsourcing of ICT mediated educational administration. The intended solution was the adoption of in-house operation with sustainable change.

BTEB’s decision on the ICT mediated administrative information system was discussed during an institution staff-meeting. The change-agent-facilitated experience of the in-house operation was discussed, and a need for a ‘strategic adoption plan’ was raised. The meeting participants suggested that the members of the academic committee and other routine administrative role players should deal in a dedicated way with this matter. So, in September 2011, six teachers and two staff were scheduled for participating in PRA exercises with the change agent. The participants’ identified problem, the performance gap, is related to the outsourcing of the services. Therefore, as the agenda of the subsequent meetings, the feasibility study involved the following questions to find out if more administrative processes could be handled in-house: 1) How do the personnel perceive the educational administration process? 2) What are the known/foreseen barriers of the in-house ICT adoption for educational administration? 3) What could be the in-house ICT adoption strategy?

Firstly, the administration process is explored by triangulating three methods, i.e. FGD, interview and participant observation. The CA facilitated FGDs among participants, conducted interviews with the founder (retired BTEB director) and the chairman, and studied (together with the principal) the BTEB’s administrative documents. The institution’s administration process was divided into two categories: ‘organizational administration’ and ‘academic administration’. For theoretical underpinning, the present paper uses the term ‘educational’ instead of ‘academic’. The organizational administration process encompasses traditional organizational department roles, which are human resource management, accounts and finance, inventory, planning and development, facilities, store and purchase, and cultural affairs. The educational administration discussed was limited to the essential use of computer and Internet for coordinating with BTEB (see Table 1). These processes and activities included the role of an ‘academic committee’ and an ‘examination committee’, which would require facilitation for in-house ICT capacity-building.

Table 1: Identified processes of web-dependent educational administration.

Process Name	ICT mediated activities
Curricula, regulations, and notices	Curricula and policy, updates & notices; <i>Probidhan</i> , details used for standard operating procedures, from admission to BTEB results (e.g. SSC Voc Probidhan from 2013)
Annual planning	Annual calendar.
Class Scheduling	Class scheduling guidelines.
Curriculum content	Search and collect from website, print and manage - core documents, amendments, policy updates, and notices.
Syllabus	Collect, print, disseminate and manage - Core syllabus, amendments, marks distribution.
Admission	Notices on instructions and deadlines, admission form record entry, prospectus collection, additional news, and document printing and management.
Registration	Registration Information Form (RIF): Registration records with date, students' individual records in a text form, uploading of scanned photos, printing and management of forms.
Assessment and Evaluation	(Public) Examination Information Form (EIF): Notices on instructions and deadlines, student record entry, management of printed forms. Marks entry: Continuous assessment and separate industrial attachment, final assessment with separate industrial attachment.
Publish Results	(Year final exams') board results access, print and dissemination, Appeal for result scrutiny and revision.

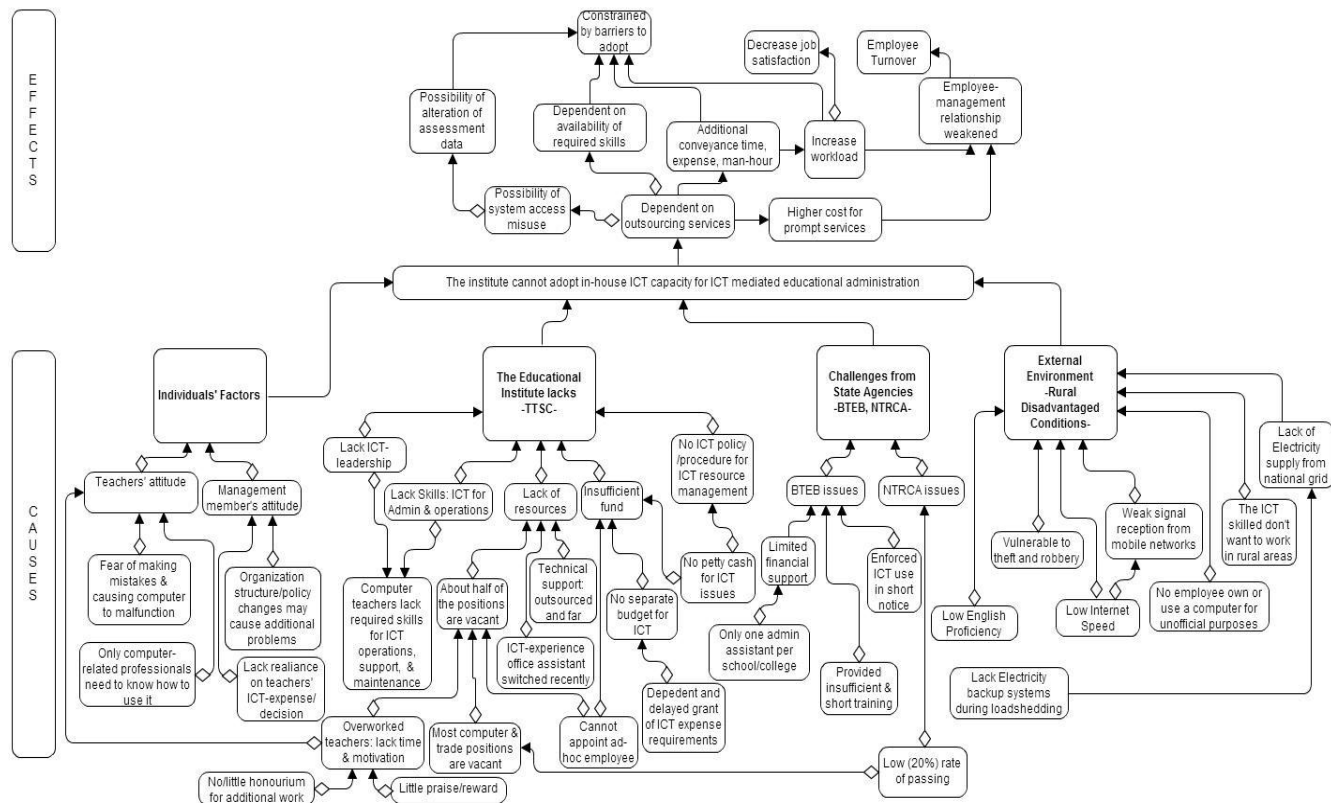


Figure 2. ICT adoption for educational administration: Problem Tree

The result of the between-method triangulation was that there should be financial and human resource capacity to deal with the use of additional peripheral devices (e.g. printer, scanner, etc.), web-based applications, office applications, and basic troubleshooting. To explore such barriers or root-causes of in-house adoption, the second agenda was raised: what are the known/foreseen barriers to the in-house ICT adoption for educational administration? In this regard, an FGD was facilitated to define a problem

statement for a problem tree analysis (PTA). The problem statement was: “the institution cannot adopt in-house ICT capacity for ICT mediated educational administration”.

In Figure 2, the problem tree diagram (Narayanasamy, 2009, p. 129) shows that the participants identified the causes to be rooted in individuals, the educational institution, the national educational agencies, and the external environment of the institution. The diagram provides qualitative insights of the interdependencies among the barriers. The barriers and effects were identified by the institution stakeholders whereas the principal researchers provided translation from the Bangladeshi language to English and added (most of) the higher level categorization.

The findings are congruent with teacher or classroom (micro-), institution (meso-) and national (macro-) level barriers of learning technologies (Lim, 2006; Looi et al., 2011) and the barriers faced by the public polytechnics institutions of Bangladesh (Abdullah-Al-Mamun, 2012).

At this stage, the challenge was to identify the key barriers to a sustainable change.

Redefining or Restructuring: The innovation is modified and re-invented to fit the organization, and organization structures are altered

Based on the PTA, the following question was discussed during two workshops: what can be a sustainable adoption strategy?

Firstly, the root causes were identified from the PTA (Figure 2): lack of: leadership, an ICT committee, funds, ICT-resource policy and procedure, an interested person to work in a rural area, skills for operation and management, knowledge and training for the role of ICT committee members, dependence on the management chairman for ICT-expenses, and reliable computers with power backup. From the systems view of school administration, the root causes might be viewed (as in Figure 2) as inputs for a transformation process.

Secondly, the workshops resulted in the formation of an ICT committee and the definition of the roles of the committee and its members. The policies and procedures of the ICT committee’s documentation rendered the details of the strategy. With reference to the CA as the consultant, the following proposals were documented for the approval of the key decision makers of the school’s management committee:

- The principal shall be the chair,
- and an elected teacher shall be the convener of the committee,
- the two (principal and elected teacher!) roles shall be responsible for a separate bank account,
- the financial issues of ICT shall be separated from the institution’s bank account,
- the consultant shall identify and provide training to an ad-hoc ICT-mediated administrative employee,
- the committee shall be able to earn from the services to the institution and from any external source,
- the income shall be spent primarily for the salary of the employee and other ICT-resources.

In addition, it was proposed that an annual fee for ICT should be charged to each student. The reasoning was that the institution will take photos for the online forms, and students will not have to spend at the photo studios. Moreover, a financial feasibility study was included, which compared estimated in-house costs and estimated outsourcing costs. Comparing three outsourcing options, the cost of communication, commuting, and services for about two years was calculated with a 7% increase in the second year. The in-house costs included hardware, software, and salary. Compared to outsourcing, the in-house adoption was acknowledged as significantly feasible – financially, operationally, and for maintenance. By January 23, 2012, the CA had identified and had trained one self-motivated HSC-graduate from the institution’s 2009-computer-trade class. He voluntarily spent 17 hours per day, six days a week, and over three months on training and working. For his ad-hoc appointment, the CA allocated BDT 36,000 (USD 453) for the salary for the next twelve months. Except for Xerox, the ICT-mediated administrative activities did not have to depend on outsourcing. The BTEB-related tasks were primarily dealt with by the principal and the office-assistant for ICT. However, the institution did not submit the ICT committee proposal for approval and waited for the second field study of the change agent.

During the second field study, the CA facilitated revision of the proposal for the ICT committee, which included an ICT-mediated administration process, and submitted the proposal to the key management. The proposal was approved except for the creation of a separate bank account. The management chairman and the founder agreed on three reasons for not approving: “firstly, we cannot promise them any incentive for all the additional efforts they will dedicate for the ICT committee. ... secondly, this innovative idea might have a challenge in the annual audit by the government, else the institution might face difficulty....one more question, will the trust and power relationship among the teachers get affected because of the new role?” However, January 2013, the idea of a separate bank account and the separation of the institution’s central financial process were approved. Therefore, the process of the adoption decision for the restructuring of the organizational process took about one year.

Clarifying: The relationship between the organization and the innovation is defined more clearly

“The clarifying stage in the innovation process in an organization consists of social construction....Through a process of the people in an organization talking about the innovation, they gradually gain a common understanding of it” (Rogers, 1995, p. 399). The participants found that the PRA exercises were convenient ways for questioning, reflecting on personal viewpoints, exploring the root causes of the problem, and suggesting a solution and in that respect the PRA exercises constructed the ICT based innovations in a new way in the organization. It was added that involving all employees on certain occasions created an environment for informal discussions and the sharing of ideas or experiences so the interaction also fostered new perspectives through social knowledge sharing and construction.

Routinizing: Innovation becomes an ongoing element in the organization’s activities, and loses its identity

The innovation adoption process in an organization is completed at the routinization stage. In addition, discontinuance can occur, and the implementation sub-process may end in failure (Rogers, 1995, pp. 399–400). In the present case, ICT-mediated administrative activities became an in-house process. However, the self-sustenance initiative through the separate financial process of the ICT committee did not reach a routinizing stage till early 2013, i.e. the process lasted about 18 months. The participants believe that discontinuance might not occur due to strong determination, a firm belief in the desired positive outcome and the strategies adopted. It was reasoned that it is less likely that the present level of required skills among the employees, the ICT-leadership strategy, and the ICT-resource strength will be lacking at the same time. However, it was added that the financial solvency of the ICT account and the turnover of the ICT-skilled employees - are two objectives to be sustained.

The role of change agent

The success of the CA depends on some factors which Rogers (1995,) stated as generalizations. All the staff of the institution assessed the CA’s contributions against a checklist of the generalizations, as part of an FGD that was facilitated by the ICT-committee and held in the absence of the CA. The participants’ agreements and comments on the list of Rogers’ generalizations are as follows. The success of diffusing ICT adoption was related to: client orientation with close rapport, high credibility level, and clients’ need; the degree to which the diffusion initiatives were compatible with clients’ need; the change agent’s empathy in being a member of a disadvantaged, rural, educational institution; high competence credibility in the eyes of the clients; the extent to which work is carried out through opinion leaders, i.e. the stakeholders in the decision-making processes of the institutions; and increased client ability to evaluate innovations.

Conclusion

The paper has addressed two objectives: how (i.e. in which processes/activities and what causes) do stakeholders of educational administration experience the barriers of ICT adoption and how do they facilitate the transformation process and address the barriers that resist the adoption. To deal with these questions, the study involved three theoretical grounds: the definition of educational administration that views educational institutions as an open system (Lunenborg & Ornstein, 2012), the innovation adoption process in an organization (Rogers, 1995, Chapter 10), and the factors associated with the success of a

change agent (Rogers, 1995, Chapter 9). In addition, the participatory learning and action (Chambers, 2008; Narayanasamy, 2009) methods and principles were applied for integrating the fundamentals of the three theoretically established concepts. More specifically, the change agent experience of the first author was used in the participatory learning and action methods as two-way diffusion communication for the transformation process of the organizational adoption process.

The stakeholders found that the barriers originate from the levels of individuals, the educational institution, the national educational agencies, and the external environment of the institution. The barriers in teaching-learning activities are categorized in the same way as micro- (individual or classroom), meso- (institutional) and macro- (national) level barriers (Lim, 2006; Looi et al., 2011). In addition, the barriers of the private institution are congruent with the barriers faced by public polytechnic institutions of Bangladesh (Abdullah-Al-Mamun, 2012), which are located in urban or semi-urban areas. Moreover, there are many-to-many dependency relationships among barriers (as in Figure 2) that alone could probably impede meaningful adoption and use of ICT. The problem-tree analysis method shows that the barriers are interconnected to the components of the learning organization (Senge, 2006).

Supporting the claim of Flyvbjerg (2006), this single-case study provided significant depth and enabled the qualitative exploration of the barriers. The participant-identified root barriers to the in-house ICT adoption for educational administration include lack of: leadership, an ICT committee, funding, ICT-resource policy and procedure, a person interested in working in a rural area, skills for operation and management, knowledge and training for ICT committee roles, dependence on a management chairman for ICT-expenses, and reliable computers with power backup. Addressing these barriers involved transformation in the open system of the institution (Lunenburg & Ornstein, 2012). In addition, complexities of the barriers in the developing context of rural Bangladesh are far greater than those reviewed. From the change agent's point of view, the facilitation involved a creative mix of the available technologies and skills, a leadership role within school and in persuading the key decision-makers, the provision of problem-based and on-site training, purchase and transportation responsibility, and financial support for the resources.

For future reference in practice and policy making our study presents two main findings. Firstly, we have shown a complex web of barriers and it is reasonable to expect a similar complexity in other institutions and even that some of the barriers will appear in other cases. We cannot, however, fully predict the specific situated barriers in other cases and that brings us to our second contribution to practice and policy: The transformative paradigm and PRA offers a perspective and a tool-box that can be used to uncover the specific barriers to ICT in any educational institution in a developing country and help to overcome some of the barriers. The bad news so far is that there is no easy quick fix in sight that can develop all educational institutions in rural Bangladesh fast.

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Paper VIII

School-based Extracurricular Contests as a Strategy to Diffusing Internet Literacy in Rural Bangladesh

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SCHOOL-BASED EXTRACURRICULAR CONTESTS AS A STRATEGY TO DIFFUSE INTERNET LITERACY IN RURAL BANGLADESH

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Based on ethnographic action research in a rural school in Bangladesh, the study addresses the underlying question of how extracurricular contests can tackle some of the barriers in relation to the diffusion of Internet literacy. The paper involves three themes. Firstly, it demonstrates a methodical approach to exploring the major barriers to adoption and integration of Internet literacy in relation to Internet use. Secondly, it applies activity theory to analyze practices and inform strategies to circumvent the barriers. Thirdly, the study applies Bloom's taxonomy of cognitive skills as a tool for developing a questionnaire and training plan for contests on Internet literacy. It also shows that searching for information on the Internet involves different cognitive skills for different individuals and varies with the type of question one is dealing with.

Keywords: extracurricular activity; Internet literacy; barriers; Bangladesh; activity theory; Bloom's taxonomy; ethnographic action research.

1. Introduction

Developing countries and disadvantaged rural contexts are increasingly emphasizing 'ICT education' and 'ICT in education', which intend to create skilled human resources for social and economic development (Islam & Grönlund, 2011; Pade, Mallinson, & Sewry, 2009). Likewise, the strategic priority of 'Vision 2021: Digital Bangladesh' on "improving the education sector through ICT in education" intends to improve teaching/learning using ICT in the educational systems of General and Technical Vocational Education and Training (TVET), literacy for students, professional development of teachers in using ICT, education related citizen services, ICT in education administration, ICT infrastructure, and delivery channels (A2I: PMO, 2009). Moreover, the national education policy of Bangladesh strongly emphasizes skill adoption on ICT through primary, secondary, vocational, and technical education (MoE, 2010, p. 31). Furthermore, the first national ICT policy highlights ICT literacy, awareness, and e-inclusion (MoICT, 2009). The national education policy of Bangladesh points out that IT should be perceived in its broader sense, that is, beyond just computers, to include mobile phones, television, radio, and networking, and all information collection, storing, and processing (MoE, 2010, p. 31). Furthermore, the first 'national ICT policy 2009' detailed a list of short, medium, and longer term strategic activities,

which attempt to achieve ICT literacy and awareness around citizen services (MoICT, 2009). These national policies call for the diffusion of ICT literacy and ICT-mediated services among the stakeholders (i.e. students, guardians, teachers, and staff) of the education system. In progressing toward the above-mentioned objectives, the efforts to integrate and adopt ICT in the classrooms have faced manifold barriers, which have been researched for decades (Khalid & Nyvang, 2013; Khan, Hasan, & Clement, 2012). One of the alternative strategies for the integration and adoption of ICT among the stakeholders of educational institutes is school-based extracurricular activities, which have scarce evidence in the field of educational technology (Farb & Matjasko, 2012; Feldman & Matjasko, 2005). Extracurricular activities in the form of contests (IT Olympiads) are also suggested as a strategy in the national strategy of Bangladesh. Hence, the present paper is devoted to testing and researching extracurricular activities as a strategy to diffuse ICT knowledge.

School-based extracurricular activities play a significant role in adolescent development (Farb & Matjasko, 2012). Recent advancements on such roles include academic performance and educational attainment outcomes, substance use, sexual activity, delinquency outcomes, and psychological adjustment (Farb & Matjasko, 2012). Moreover, extracurricular activities can considerably contribute to the process of active citizenship education (Keser, Akar, & Yildirim, 2011). Furthermore, Khalid and Nyvang (2013) identified that secondary level curricula in Bangladesh (including TVET) lack content on Internet and the institutions' lack of technical teachers and teachers' lack of knowledge and skills are barriers to gaining Internet skills to access information, services, and learning resources. The present paper researches change agent facilitation for situated hands-on training and assessment as part of extracurricular contests, which can be a strategic approach to circumvent the barriers and to integrate and adopt ICT in the formal and informal learning practices. Thus, as part of an Ethnographic Action Research (EAR) project, two types of extracurricular contests (ECC)—named the *Mobile Master Contest* (which uses mobile phones) and the *Internet Master Contest* (which uses laptops and USB modems)—were facilitated in an interval of one year in the rural context of Bangladesh. The contests were situated in a junior secondary school and a TVET institute. The idea of these two types of school-based ECC originated from the two schools' participants, whom I facilitated to take part in the first mobile-based Internet searching national contest in Bangladesh, called I-Genious (Grameenphone, 2011).

This paper demonstrates that school-based extracurricular contests can be an alternative strategy to diffuse Internet literacy as well as a formal, purposeful, and systemic activity for developing cognitive skills. The underlying research question is, "How can school-based extracurricular contests address some of the barriers in relation to the diffusion of Internet literacy?" To address this question, this paper begins with three aspects of the research background. First, it covers the definition of Internet literacy, the trend of common Internet use, and the use of the Internet as a learning activity. Second, the components of the activity system model of activity theory (Vygotskii & Cole, 1978) are illustrated as an approach to designing extracurricular contests as learning activities.

Third, drawing from the educational technology barriers in curricular activities, access and understanding aspects are elaborated. Then, EAR methodology, methods, and a brief about the field studies are presented. Lastly, the analysis and discussion in relation to the three research aspects are followed by concluding remarks.

2. Research Background

2.1. The Denotations of the Components of Activity Theory in the Design of ECC

The first point of departure is taken from Hong et al.'s (2013) situated design of an extracurricular contest as an activity system, which is central to the cultural-historical activity theory (Engeström, 2005; Engeström, 1999; Leont'ev, 1978; Vygotskii & Cole, 1978). Hong et al. conclude, "From cultural-historical activity theory, a model of change with the potential to drive innovation in practice, this empirical study of the STC [science and technology club] presented a new practice to improve student creative science and technology learning" (2013, p. 52). Accordingly, in the case of the current research, the ECC is designed as a similar model for the diffusion of an innovation in practice—Internet literacy, both for the participants and the organizing party. The design of the ECC is illustrated by the activity system model in Figure 1. Although the underlying idea about denoting activity theory components in extracurricular activities is the same as Hong et al., this study is different in relation to context, methodology, and research aim.

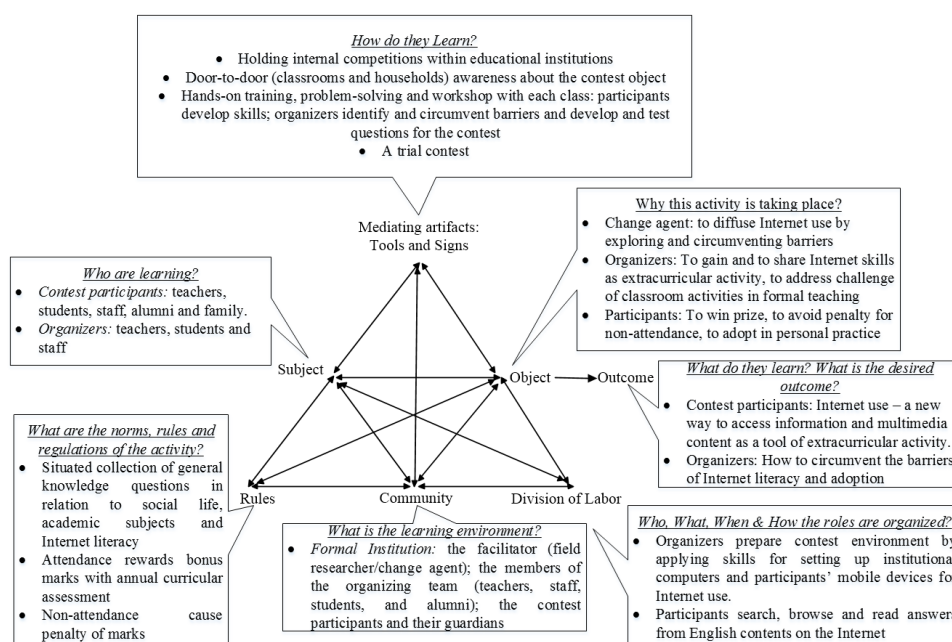


Figure 1. An activity system model of an extracurricular contest (based on Engeström, 2005, p. 61; Hong et al., 2013, p. 52).

It is necessary to mention that the illustration evolved and was also applied during the EAR process (as in section 3.1), which relied on methodical exercises with contest participants (i.e. teachers, students, and staff), participant students' local guardians, and organizers (i.e. teachers, staff, students, and the field researcher). Although each of the components and their relationships to the activity system were used as part of the change agent facilitation process, the activity system was not used as a mediating tool for any participatory design method. So, in this paper I apply this model as a tool to analyze the barriers and subsequent solving/circumventing strategies that were raised and researched by the participants and for the participants.

2.2. *Functional Internet Literacy and Bloom's Taxonomy*

As a second point of departure from Johnson's (2007) mapping of Bloom's taxonomy of cognitive skills against common Internet activities, this section defines Internet literacy and argues for the application of Bloom's taxonomy for designing an extracurricular/learning activity that will diffuse Internet literacy.

Existing definitions of *Internet literacy* are neither consistent nor beyond ambiguity. For instance, *Internet information literacy* is defined as the capability to access and evaluate online information (Eisenberg & Johnson, 2002), or online search competence (Harkham Semas, 2002), or more comprehensively as skills including connectivity, security, communication, multimedia, and webpage development (Hofstetter, 2006). Following the UK's Communication Act 2003, a more reliable definition of *Internet literacy* can be constructed from the definition of *media literacy*, as "the ability to access, understand and create communications in a variety of forms" (Livingstone, Bober, & Helsper, 2005, p. 6). This approach to *media literacy* comprises the following:

Access. Internet literacy is required to access both hardware and online contents and services, and to regulate the conditions of access.

Understanding. Internet literacy is crucial for effective, discerning and critical evaluation of information and opportunities online.

Creation. Internet literacy permits the users to become an active producer as well as a receiver of content, enabling interactivity and participation online. (Livingstone et al., 2005, p. 6)

However, Johnson (2007) argues that the ability to develop a webpage is not a *functional* skill, as it is not a pre-requisite to typical Internet use (cites, Statistics Canada, 2004; US Census Bureau, 2005; Australian Government, 2005). Yet, despite these not-so-old references, Internet literacy should include content *creation*, which is required by the recent developments in the use of web 2.0 and beyond. As part of this EAR, the contestants' search and browse actions and the organizers' trainings and preparations during the ECC required the literacy of Internet access and understanding. Therefore, to design and experiment with the ECC as a diffusion strategy, existing levels of access and

understanding were explored. In addition, existing barriers to achieving these two aspects of *Internet literacy* were identified.

Johnson's (2007) review of the patterns of Internet use shows that common Internet activities can be grouped into five categories: (1) communication (e.g. bulletin boards, chat and email, instant messaging); (2) information (e.g. health, personal, interest); (3) recreation (e.g. movies, music, games); (4) commercial (e.g. banking and investments, purchase products, access services); and (5) technical (e.g. connectivity, security, downloads). Johnson also showed that the uses of the Internet are a demonstration of cognitive skills or learning activities.

It is sufficiently established that "defining functional Internet literacy in terms of a hierarchy of cognitive skills accounts for age and education differences in patterns of use and the degree of online vulnerability" (Johnson, 2007, p. 436), as "maturation (i.e. age) and experience (e.g. education) contribute to the development of higher-order thinking skills" (Johnson, 2007, pp. 436-437, cited in Yan, 2005). So, Johnson (2007) demonstrates Bloom's taxonomy of hierarchical categories of cognitive skills in relation to common Internet use. However, cognitive skills cover only one of the three domains of a learning activity, namely, cognitive (or knowledge), psychomotor (or skills), and affective (attitude) domains (Anderson & Krathwohl, 2001; Bloom, 1956; Krathwohl, Bloom, & Masia, 1964). Hence, as a learning activity, a formal extracurricular activity for the diffusion of functional Internet literacy can be founded on a mapping between the categories of Internet use and Bloom's taxonomy. Bloom's taxonomy guides the goal-oriented design of the learning activity. Thus, this paper demonstrates how Bloom's taxonomy can be applied to design a school-based extracurricular activity for the diffusion of skills, knowledge, and positive attitudes on Internet use. In particular, the cognitive domain guides the design and analysis of skills in relation to Internet use during training and the contest.

2.3. Diffusion of Innovations: Circumventing the Barriers at Organizational and Individual Levels

The activity system is a powerful framework for explaining the concept of *contradictions* (Engeström, 1999). Contradictions occur when a new way of doing or thinking conflicts with currently or traditionally accepted ways of doing or thinking and it may arise among activities, between elements, or each of the elements, ensuing in tensions within the system (Avis, 2009). The problem or barriers can be explained by the application of activity theory (Roth, Huang, Goulhart, & Lee, 2005). Barab, Barnett, Yamagata-Lynch, Squire, and Keating (2002) have used activity theory to identify and solve the contradictions of an educational setting. Given the evolving nature of the extracurricular contests, the inquiries of this study focused on problem articulation, how the problems and problem goals are identified and solved over time.

The activity model of ECC addresses the problem that the students are not acquiring Internet literacy from the schools, and this problem is more prevalent among the rural, private, and vocational institutions of Bangladesh and developing countries alike (Khalid & Nyvang, 2013). In addition, the article identifies that the ICT adoption barriers are

associated with the socio-cultural and infrastructure factors that surround an educational institution, organizational factors as part of the institution, and individual-level factors, which resonates with Rogers (1995). Moreover, strategies to diffuse ICT in curricular activities are faced with a significant number of barriers, which are related to curriculum revision, continuous change, teaching learning practices, state assessment system, motivation and perceived value, continuous support and maintenance, and various social factors (Hew & Brush, 2006). Accordingly, this paper contends that the strategic goals to provide “Internet literacy for learning” and diffuse “education related citizen services” can be strongly contributed by school-based extracurricular activities, which can also complement and circumvent the barriers to the diffusion of ICT in relation to curricular activities. Furthermore, educational institutions have greater flexibility and autonomy to design extracurricular activities, which do not depend on state tests and the rigidities of the requirements for covering textbook contents. Hence, this section briefly reviews the barriers associated with the Internet literacy of access and understanding, as defined in section 2.1. In addition, this review draws attention to the diffusion process at the organizational level and the individual level (Rogers, 1995) while experiencing the extracurricular activity that is designed for providing Internet literacy.

The educational technology literature reports the barriers of access associated with ICT and Internet literacy. These are lack of electricity and poor Internet speed within a country, lack of hardware and software, lack of technical support (Afshari, Bakar, Luan, Samah, & Fooi, 2009; Khan, Hasan, & Clement, 2012; Wachira & Keengwe, 2010), lack of funding, lack of IT teachers and on-site trainers (Khalid & Nyvang, 2013). The Government of Bangladesh has banned the use of mobile phones during classes and examinations at all education institutions (The Daily Star, 2011). Technical (e.g. connectivity, security, downloads) use of the Internet (Johnson, 2007) involves the skills like technical support, which is part of the ‘access’ literacy, as defined in section 2.1. Therefore, lack of technical support is the underlying barrier. Porter and Donthu “found that age, education, income and race are associated differentially with certain beliefs about the Internet, and that these beliefs mediate consumer attitudes toward and, ultimately, use of the Internet” and “older, less educated, minority and lower income individuals have lower Internet usage rates than those of younger, highly educated, white and wealthier individuals” (2006, p. 1005).

In relation to the ‘understanding’ of information and opportunities online, a frequently reported barrier is the difference between mother-tongue and the language of ICT interface and content; this barrier is typically related to low English proficiency (Khan et al., 2012, p. 70; Sharma, 2003, p. 514). In Bangladesh, hardware and software interfaces are predominantly English; searching in Bengali is complex (Pal, Majumder, Mitra, Mitra, & Sen, 2008), and English is given higher preference both for searching information and for content creation. The high rate of failure in English in state tests confirms that English language proficiency is one of the greatest challenges at the secondary education level. Therefore, the ECC facilitates gaining abilities for ‘understanding’ online content.

In light of the above review, this study is an attempt to demonstrate how the extracurricular contests can address some of the barriers, principally ‘access and understanding’.

In designing an extracurricular activity for the diffusion of ICT, the barriers of “knowledge and skills” can be faced (Hew & Brush, 2006), which the organizer teacher and students may lack. In light of Hew and Brush (2006), the knowledge and skills barriers can be of three types: lack of specific technology knowledge and skills, technology-supported-pedagogical knowledge and skills, technology-related-extracurricular activity management knowledge and skills.

This research presents an EAR (Tacchi, Foth, & Hearn, 2007), which is applied as the exploratory and inductive strategy development (Regnér, 2003). First, based on the findings of Khalid and Nyvang (2013), the lack of specific technology knowledge and skills were addressed through in-situ facilitation by the field researcher. Second, based on Bloom’s taxonomy and activity theory, the technology-supported-pedagogical knowledge of the field research was incorporated into the design of the questions and the activity of the extracurricular contest. Here, technology functions as *transformation*, because the

use of technology as transformation has the potential to provide innovative educational opportunities by reorganizing students’ cognitive processes and problem solving activities (Hew & Brush, 2006, p. 228)

Third, through participatory planning and implementation, the experience of the institution’s teachers and the field researcher addressed the technology-related-extracurricular activity management knowledge and skills requirements. Particularly, the field researcher and the student participants of the I-Genious contest gained the knowledge through observation and adapted this in organizing the intra-school contests.

3. Methodology, Methods, and the Case

3.1. *Ethnographic Action Research*

This study is established on a transformative research paradigm, which advocates action research, ethnographic research, and participatory and mixed-methods for sustainable change among both the researchers and the participants through bi-directional communication (Creswell, 2003; Mackenzie & Knipe, 2006; Mertens, 2007, 2010; Mertens, 2010). So, this study applies an EAR methodology, because UNESCO recognizes it as one of the research approaches for strategizing ICT for sustainable development (Hartmann, Fischer, & Haymaker, 2009; Tacchi, Foth, & Hearn, 2009; Tacchi, Slater, & Hearn, 2003; Tacchi et al., 2007). The EAR methodology combines two research approaches: *ethnographic* and *action*. “Ethnography is a research approach that has traditionally been used to understand different cultures. Action research is used to

bring about new activities through new understandings of situations” (Tacchi et al., 2003, p. 1).

The action research components involve (1) *criticism* of barriers or dissatisfactory conditions within a given field, (2) *investigation* and *documentation*, (3) *reflection* through the *development of a concrete vision* and *transformation strategy*, (4) *action* to experiment with the strategy for further criticism (Andersen & Bilfeldt, 2010). So, in the previous section, the first step of the investigation—introducing the barriers in the research field and in the context of this research—is documented (see Khalid & Nyvang, 2013). The transformation strategy is blended within the theoretical frames of activity theory and Bloom’s taxonomy in designing the extracurricular activity, and the action-based experiences are presented later in the discussion. Moreover, the idea of action research stresses that for collective action based on the participants’ needs, experiences, and visions, the research questions and agenda should be defined together with the research stakeholders and preferably raised by the participants (Reason & Bradbury, 2008). Accordingly, in this research, the inquiry began to be formulated as the principal of the institution asked the field researcher to take responsibility for preparing students for participating in the national I-Genious contest as none of the teachers had the ability. Later, while returning from the contest venue, the participants suggested that the field researcher should facilitate an intra-institute extracurricular contest as a way of boosting Internet literacy. Thus, we (the participants and I) investigated if extracurricular contests could be a strategy to diffuse Internet literacy based on a cyclical methodology of EAR.

The ethnographic research component of EAR stresses participation in action, mixed-methods, and field-based activities. While the broad definition of action research does not bring specific principles, theories, and methods (Reason & Bradbury, 2008), the ethnographic research trend brings along the methods and triangulation principle of participatory action research (PAR) (Tacchi et al., 2009). One of the trends of methods under the umbrella of PAR is participatory rural appraisal (PRA) (Chambers, 2008; Narayanasamy, 2009). PRA is also well-established among the NGOs and state-funded development agencies of Bangladesh, namely BRAC, TMSS, PROSHIKA, RDA, and BARD. So, this paper is part of a research project that applies PRA methods and principles for exploring multiple intervention strategies for the diffusion of ICT education (e.g. Khalid & Nyvang, 2013; Khalid, 2011). Before an elaboration on the application of the methods, the field study is briefly discussed in the next section. Building on these methods (Tacchi et al., 2009), an EAR project involves people in all three phases of planning, doing, and research (Tacchi et al., 2003).

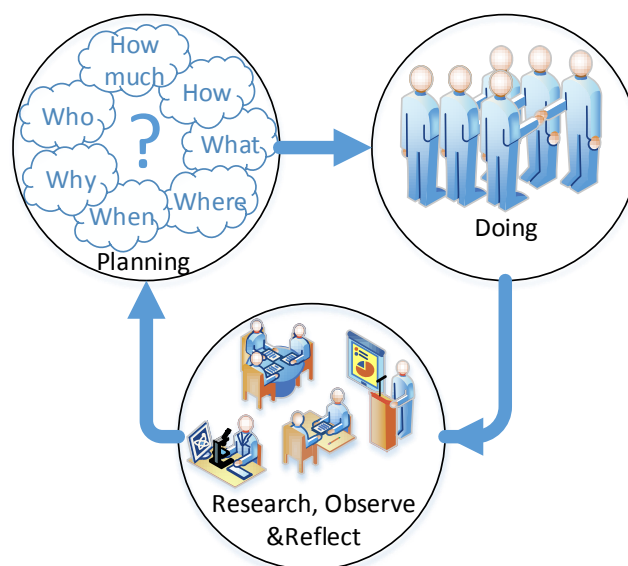


Figure 2. Iterative and cyclical phases of ethnographic action research.

3.2. The Field Study

About 80% of institutes (i.e. 15,285 of 19,083) in Bangladesh general secondary education (including junior secondary school, secondary school, and school and college) are rural (BANBEIS, 2010a). Among these schools, more than 98% (18,766 of 19,083) are private, and among the private schools more than 81% (15,257 of 18,766) are in the rural areas (BANBEIS, 2010a). The case for the secondary level vocational institutions is similar. Moreover, the Bangladesh national education policy strongly emphasizes ‘vocational and technical education’ and ‘information technology education’ (MoE, 2010, pp. 15-17, 31-32). Furthermore, it is presumed that the stakeholders of a technical-vocational institution have a positive attitude toward ICT, because it is compulsory for such an institution to have a hands-on computer course as a pre-requisite for embellishment. So, situating an educational technology diffusion study in Bangladesh can very well begin with a private vocational institute in a rural area.

Situating the study in Tofail Ali technical school and college (TTSC), a private TVET institution in a village of Brahmanbaria, was a result of convenience sampling as I had acquaintances with the founder and the chairperson of the institute, had organized voluntary computer training in the school, and had formerly experienced the barriers. In response to the request for situating this project, I was formally accepted as a consultant of TTSC and was accorded with authority and freedom to explore and experiment with possible ways of diffusing ICT among the stakeholders (i.e. teachers, staff, students, parents, and management) of the institution. From this role as an insider yet with complete task independence, the intention was to facilitate communication about innovative ideas of ICT adoption across different stakeholder groups, for instance

teachers versus students and employees versus school management. More specifically, as a change agent, I returned to the institute with former experiences and with the intention to further explore and address the barriers and to create needs awareness in relation to ICT in education (Rogers, 1995, Chapters 5, 9). Through the process of facilitation, I tried to utilize my experiences from the field of computer science and educational technology as the role of a change agent (Rogers, 1995, Chapter 9). Two live-in field studies were conducted during August 2011 to January 2012 and from August 20, 2012 to September 29, 2012.

Soon after beginning the first field study, the employees (i.e. teachers and staff) and management suggested that two more schools should be considered as part of the research activities, because the three institutions share their workload and other resources. All three institutions were founded by the same individual and the two schools were established as “feeder institutes for quality students for the TVET institution and for surviving amidst the politics related to inter-school competition”, as reflected by the founder, senior teachers, and other management members. The two institutions are Tofail Ali Technical School and College – Junior School (TTSC-JS) including sixth to eighth class and Tofail Ali Kindergarten (TAKG) for pre-school to primary level. During the field studies, TAKG only had playgroup, nursery, and KG classes. TTSC falls under the technical-vocational education system and the other two fall under the general education system of Bangladesh. To elucidate, Bangladesh has three major systems of the centralized education system, which include general education, madrasah education (i.e. Islamic education), and technical vocational education (BANBEIS, 2010b). Considering the politics, procedures, policies, and practices across the institutions, the teachers and management agreed to grant me a consulting role for all three institutions. This paper on extracurricular activities elaborates the subsequent experience on the *innovation process* in the organizational structure of these three schools (Rogers, 1995, Chapter 10). The role was made possible due to the vested trust and authority in me, the authority decision of the management, a collective agreement, supportive efforts by the teachers and staff, and enthusiasm among the young students and other participants toward Internet literacy.

Historically, the vocational institute initiates extracurricular activities and various festive events and the junior secondary school and the kindergarten support them. In some cases, the kindergarten participates as audience members, if active participation is not possible. During the ECC, the kindergarten teachers were contestants and the students were audience members. All the employees and students of TTSC and TTSC-JS had the opportunity to receive training for and participate in the school-based contests.

The first field study included the experience of facilitating students to participate in the national I-Genious contest involving doing Google searches on a mobile phone, facilitating through organizing and training for a mobile phone based searching contest called the *Mobile Master Contest 2011 (MMC1)*, and followed by a laptop based searching contest called the *Internet Master Contest 2011 (IMC1)*. By the time the second field study had begun, most of the key technical support and training resource-persons had passed their school or college certification examination and moved to other

institutions in the city. Therefore, during the second field study only one *Internet Master Contest 2012 (IMC2)* could be organized and a plan to hold the *Mobile Master Contest 2012 (MMC2)* was cancelled due to the absence of some resourceful core organizer students, who had graduated from TTSC. By the time I returned to the village, the staff and students of the organizing team had gained sufficient skills and confidence to organize a laptop based Internet literacy contest. So, during the IMC2, I retained the task of partially changing the former contest's questionnaire, as participation in the contest was mandatory for all the teachers and students.

3.3. *Methods*

According to the PLA/PAR umbrella of methods, the field study can be viewed as a broad method called *cultural transect*. Cultural transect enables the researcher(s)

to traverse through the 'life' of a person, a subsect of the village, or the village itself over a period of time (it may be a day, or a week, or more). It involves attaching oneself to a person, subsect, or village and following through on a journey of observations and discussions to discover patterns of daily life and why they are what they are. (Mascarenhas, 1992).

Among the umbrella of PLA methods and principles (Chambers, Howes, Lipton, & Strecton, 1996; Chambers, 1994a, 1994b), the 'cultural transect' is an interesting variant of the transect methods. As opposed to the often-debated quick and dirty mixed-methods approach of PLA applications, cultural transect offers an opportunity for a participation-in-action approach that is adapted into the historical tradition of ethnographic research. To clarify, during the field study, I lived as a paying guest but more as a family member during the entire stay. A list of my not-so-structured activities include administrative support, teaching, fundraising for the school and community, facilitating official meetings, conducting in-house training, student counseling, winter cloth distribution among villagers for charity, attending local cultural events and festivities, organizing trainings and workshops, etcetera as part of being a member of different communities and as a researcher cum change agent. Apart from experiencing the events, interactions, actions, and sensing the very situated environment, I collected data using a diary like an ethnographer, either in the form of text or voice records, images, videos, drafts of formal and informal documents, and notes on the discussions, participant/non-participant observations, face-to-face interactions and activities. For the extracurricular activities, I prepared notices, inquired about current mobile and Internet access, conducted training for hands-on Internet literacy, arranged funding for the events, identified students and teachers with motivation and skills for taking change agent and support activity roles, etcetera. This cultural transect method enabled convenient in-situ planning and facilitation. However, for articulation in this paper, I shall build on the more traditional methods as part of the PLA methods, following the technique demonstrated by Khalid

and Nyvang (2013). Principally, these methods include focus group discussion (FGD) and semi structured interview (SSI).

The contest participants, organizers, and teachers were facilitated through focus group discussions, interviews, observations, training, and workshops. These were organized for each of the EAR cycles for each of the contests. Therefore, these methods involved the facilitation of the stakeholders through at least four iterations of multi-phase activities of the EAR (as in Figure 2). It is important to mention that activity theory and Bloom's taxonomy are the researcher's personal selection of tool (resulting from research) for analyzing the iterative experiences of the ECC. As part of the participatory activities of the EAR phases, the components of the theories were used as facilitating tools. However, the theoretical details were not communicated to the participants, as it was anticipated that this would increase the complexities of understanding the decision/discussion objectives. The details of the participants and methods are presented as part of the analysis and discussion.

4. Analysis and Discussion

This analysis and discussion is based on triangulation of my ethnographic notes, PLA methods, and documents of the ECC events. These are analyzed in two broad subsections. First, the barriers in organizing and adopting the contests as institutional practice are discussed and analyzed as an activity system. Second, the training and question preparation exercises are discussed in relation to the barriers. The methods are presented as the mediating tool of the activity system, and using Bloom's taxonomy the analysis demonstrates that the Internet search for information involves cognitive skills.

4.1. Research and Planning on Addressing the Barriers of Organizing Extracurricular Contests on Internet Literacy

In this part of the analysis and discussion, I construct upon the application of the cyclical EAR methodology in this research (Figure 3), where the contests are the actions phase and the research and planning (R&P) phases follow an initial action. The intentions are to emphasize the identified barriers, how these are addressed, and how the components of the activity system model (Figure 1) enable the development of strategies for the diffusion of Internet literacy. Figure 3 shows that in the case of this research, the inquiry about the adoption of extracurricular contests as a school-based event began after experiencing the action first. So, the R&P arrows show that the school-based events began with research on a former event and planning on a subsequent event. Organizing the event depended on the cumulative explorations and findings from the research and planning of the previous events. Therefore, I merge the research and planning phases for the convenience of discussing the barriers and analyzing them in relation to the activity system.

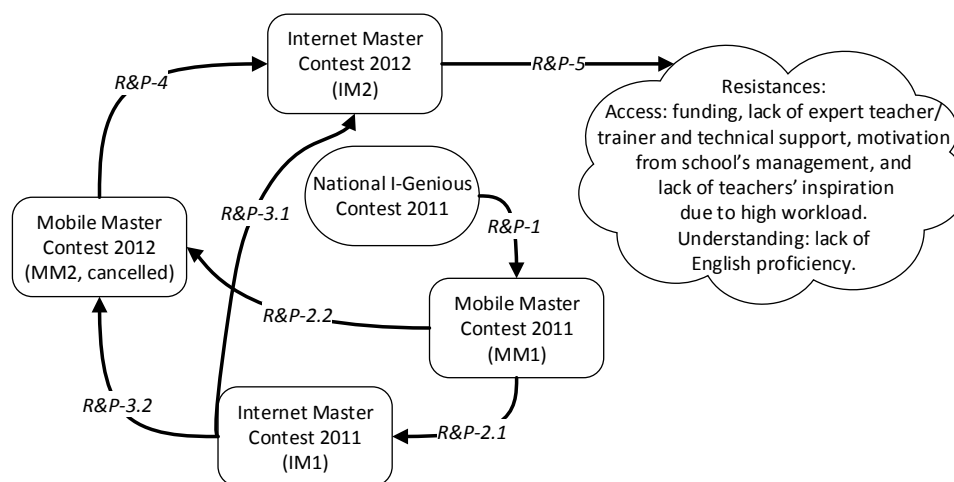


Figure 3. Phases of ethnographic action research on extracurricular contests.

4.1.1.1. *National I-Genious Contest 2011: R&P-1*

The agenda of this EAR began with actions to address some barriers. The principal pointed out three barriers at the time of handing me five contestant forms for the I-Genious contest. These three barriers were as follows: both institutions had a lack of teachers, none of the teachers had Internet skills for taking this responsibility, and lack of technical support for facilitation. My responsibility was to facilitate in training, selecting, and representing TTSC & TTSC-JS in the I-Genious contest. The belief was that my skills and role as a teacher would address these barriers. Then, in my search to identify a recognized leader for extracurricular activities, the teachers and students univocally pointed out the accounting lecturer of TTSC. The lecturer and I conducted motivational discussions in each class to persuade students to express interest in training and prospective participation. The scope could not be offered to class eight and nine as they were busy preparing for state tests and other classes of TTSC and TTSC-JS responded by attending focus group discussion sessions (FGDs). In addition, interested participants were informed that they would have to bring their own/borrowed mobile phone with an Internet browser and pay for a personal Internet subscription.

To plan the training, FGDs with seven female and six male students from class six and 17 male students from other classes raised and discussed the following questions:

- (1) Is a student allowed to bring a mobile phone to school for learning to use the Internet?
- (2) How can we identify that a mobile in the house or a borrowed one has Internet features?
- (3) How much does it cost to use the Internet?
- (4) How to subscribe to the Internet from different mobile operators?
- (5) How to configure a mobile phone for Internet access?
- (6) For the competition, what do we have to do with the 'Internet thing'?

To address these issues, first, the principal clarified the regulation that mobile phones cannot be used during classes and examinations (The Daily Star, 2011). For the remaining technical issues and related information, we needed to find people who knew at least something about these questions. So, the outcome of the first training/workshop was identifying skilled individuals and the formation of a team, which included technical support skills and strong potential to become a trainer. The students identified and brought along four key resource persons. First, Pritom of class ten is an advanced user of computers and mobile phones; he can configure any mobile and laptop for Internet access, knows the configuration differences among all telecom operators in Bangladesh, and the rules of the I-Genious contest, and can find the required information online for configuring. Second and third, Junadi of class eleven and Tanvir of class ten are Internet users and can help with configuration, subscription, and the searching process. Fourth, Rajib is an alumnus of TTSC's class of 2009, teaches in the kindergarten section, and has a strong aptitude for training, guiding, and coordinating skills. Fifth, Sazzad knows about the cost issues for different subscribers and that from the school it is possible to top-up directly from his father's shop. Last, the principal and the accounting lecturer Mr. Salim were additionally identified for financial support and rooms for training. However, the roles were not strictly confined to individuals, rather others contributed as soon as the skills and knowledge started to evolve and transfer. For instance, Pritom taught us that "if a mobile has a camera, it will have an Internet browsing feature" and we found that this holds true in most cases. A quick survey identified that we were subscribers of one of the three major operators in Bangladesh. So, Pritom summarized the information related to Internet configuration and prepared summary documents for others to use. We studied various subscription types offered by these companies, identified preferred duration type, and made a summary table for individuals to decide. Different types of configuration systems for diverse types of mobiles, including those with a double SIM, were configured and installed with more convenient browser software.

In the process of addressing the above-discussed barriers, the components of the activity system of the contests started to take an agreed formation (refer to Figure 1). For instance, in the *division of labor* component, we were trainers of each other and we all were learners in the process of gaining access or understanding in relation to Internet literacy. Being the *subjects* of the activity system, each of the students, teachers, alumni, and the researcher were learning these skills for the motivation posed by the *object*. While I was motivated to facilitate addressing the barriers, the organizing team was inspired to share their Internet skills and for some participants there were many different motivations—possibly the most common was to win, get some prizes, and have their photo in the national newspaper. The *rule* for being one of the five contestants representing TTSC was to be able to demonstrate best performance. I asked a number of questions to 19 candidates until at least 11 of them gave the right answer to my question on searching and showing the right answer. After every third right answer, one candidate was selected as the I-Genious contestant and the preparation content continued for the rest. The students reflected that the rules for demonstrating performance were motivating

for more practice, but when an unknown technical difficulty disrupted the ability to prove the skill, then it was somewhat frustrating. Similar reflections after the I-Genious contest indicate that the *outcomes* are more than gaining the skills related to Internet literacy; these contests develop certain attitudes toward the technology and about the contests. For instance, “female students become more shy after class seven”, “we proved that we are from a good technical institution, because two of us were among the nine finalists, there were 14 institutions and one institution had about 16 contestants”, and “the organizers were biased toward female students just because they wanted to ensure more participation from them”. The I-Genious contest created a feeling of *community* among Internet users. This feeling is reflected as Rajib and Pritom proposed organizing an intra-school contest, other contestants expressed strong determination to take organizational responsibility and supported the idea by saying, “Many of our friends were interested but they were just shy or somehow did not come to training. I shall convince them to get training and attend the contest”. Eventually, the principal and other teachers supported the idea. I took responsibility of the funding barrier. An FGD and SSIs with the contestants on the question “How did you learn?” revealed that it was possible to learn because there were ample opportunities for hands-on training, the opportunity to observe, try, help from peers to address complexity, persuading about the relative advantage, and institutional encouragement. So, the *mediating artifacts or the tools and signs* component of the activity system principally include peer training, institutional motivation, and school-based facilitation of technical barriers.

These findings from the I-Genious contest contributed to the overall planning and research inquiry development for the first Mobile Master Contest 2011 and beyond. The planning involved creating opportunities for more stakeholders to attend or at least become aware of the event.

4.1.2. *Mobile Master Contest 2011: R&P-2.1 and R&P-2.2*

After the contest, based on the FGDs in each of the classes and workshops with the organizing teachers and students, I facilitated the research on barriers. The varying inquiries and barriers pointed out in these different settings and groups were analyzed as follows. One of the tools to begin the facilitation was Table 1, which shows the four groups of contestants of the day-long event. The three initial inquiries were, (1) despite official formal notification, why was teachers’ attendance very low, (2) why did some of the female students not come to the stage for the contest although they were registered?, (3) why was there relatively lower student participation than predicted by the student organizers?

To emphasize the participation of female students, the total population of students (Table 2) was brought into the focus group discussions. Although there is a high percentage of females enrolled in each of the classes, the percentages of registration and attendance were very low. It was also pointed out that the registration was a result of door-to-door communication, but the eventual attendance was significantly low, even in the case of male students (as shown in Table 1).

Table 1. 'Mobile Master Contest 2011' Registration and Attendance

Group	Class	Registered			Attended		
		M	F (%)	Total	M	F (%)	Total
A: TAJIS students	VI	0	2 (100)	2	0	0	0
	VII	3	3 (50)	6	3	1	4
	VIII	JSC exam		-	-	-	-
B: TTSC students	IX	7	4 (36)	11	3	4	7
	X	8	4 (33)	12	3	1	4
	XI	8	3 (27)	11	4	1	5
	XII	9	4 (36)	13	7	1	8
Sub-total (students)	-	35	20 (36)	55	20	8 (29)	28
C: Teachers and family	-	11	9 (45)	20	7	4	11
D: Students' kin and alumni	-	13	1 (07)	14	4	0	4
Total		56	25 (31)	81	28	11 (28)	39

Table 2. Student Population of the Study Institutes

Institution	Class	M	F (%)	Total
Tofail Ali Technical School and College – Junior Section	VI	15	39 (72)	54
	VII	19	32 (63)	51
	VIII	25	25 (50)	50
Tofail Ali Technical School and College	IX (4 trades)	20	27 (57)	47
	Computer	08	11	19
	Poultry	05	04	09
	Dress Making	0	12	12
	Electrical	07	0	07
	X (4 trades)	25	22 (47)	47
	Computer	06	09	15
	Poultry	09	0	09
	Dress Making	0	13	13
	Electrical	10	0	10
	XI (2 trades)	23	16 (41)	39
	Accounting	13	10	23
	Computer	10	06	16
	XII (2 trades)	25	12 (32)	37
	Accounting	16	04	20
	Computer	09	08	17
	Grand Total	149	173 (54)	322

A formal meeting with teachers and informal discussions with both teachers and students were conducted to address the attendance and participation issues identified regarding the Mobile Master Contest 2011. A senior teacher's comment resonates and summarizes the discussions and meetings as follows, "We decide a teachers' committee for each event and typically those teachers do everything and in some cases the volunteering students are the only student participants. In cases when the founder or committee members of such a level are present, there are many obligations felt by the teachers and the students are highly encouraged to attend. At times, the games, sports, and entertainment events attract a relatively higher number of students. But, depending on the type of event, in one kind of activity there are more males and in others there are more females attending and participating. Moreover, we [teachers] do not have any reward or benefit for organizing the events, which is additional workload to the already doubled teaching load than appointed for. Similarly, students also do not get any reward and the only possible punishment is motivating words with some decent scolding". In addition, it was stressed that the event was held on the only weekly holiday and considering the immense importance of Internet literacy or other extracurricular activities alike should be held on a weekday. So, it was discussed that some *rules* and motivation (i.e. *object*) have to be integrated into the contest (i.e. the activity system) to increase the rate of participation. Therefore, it was planned that subsequent contests will be held on a working day to ensure the dedicated participation of employees. In addition, the academic and examination committee members decided and approved that for subsequent contests there will be a reward of ten marks and a punishment of five marks, because after much deliberation we identified that assessment marks are the most valuable reward or punishment factor for the students and their guardians. These marks will be adjusted with the total curriculum score of the year-end marksheet and as part of the attendance marks. For the full score of the reward, a student has to be present during three roll-calls during the beginning, half-way, and at the end of the program. Moreover, for subsequent contests, the provision for registration fees for contestants will be discontinued, class teachers and the captain of the class provided a list of participants to the organizing team, and about 30-40 students volunteered for various organizational support roles.

A list of barriers to holding such an event was prepared for further planning. Most importantly, funding is pre-requisite to taking the initiative of organizing an event, followed by motivation from the management committee, and inspiration among teachers. The rest are lack of interest among female students, the low level of education among guardians and parents, participation would have been much less if door-to-door (i.e. each classroom and households of students) visits to motivate the students and the parents had not been done, learning could have been significantly reduced if students were not the organizers and the trainers.

In the planning meeting for the Mobile Master Contest 2012 with teachers and students of the former organizing team, the plan to hold the event was cancelled. The key barrier was two-fold. First, three of the four most reliable technical support people for Internet-based mobile subscription and setup passed their secondary or higher secondary

school certification examination and were not available to help organize the event. The other organizing members were not prepared for confident support and the time for technical support and training might take much longer than allocable. Second, the high workload caused by some sicknesses, state examination related responsibilities and the school's upcoming internal examination left less allocable time. However, it was suggested that the Internet Master 2012 could be held with more enthusiasm, because the teachers and students gained more confidence with laptop based Internet service and setup during and after the last Internet Master Contest. It was also mentioned that as part of this project, the institution and some teachers became owners of personal laptops, received Internet training, and gained more experience as part of personal and academic uses for information and communication.

4.1.3. *Internet Master Contest 2011: R&P-3.1*

The organizing team reflected that a great deal of technical know-how and organizing skills were gained that are necessary for organizing this kind of extracurricular activity. Previously, the central barrier had been a lack of technically skilled teachers who could facilitate in staging these skills. Some of the discussed barriers and the solutions are as follows. A laptop is a reliable alternative in this rural area, because it gives sufficient power backup during load shedding. The institution has an EDGE modem that could not be utilized in the event. Nevertheless, after visiting the support center of the telecom operator, an expert in the location could solve and explain the problem. It required experimentation with multiple operators' subscription models to decide and select the best operator, which was then subscribed to for all eight modems. The search response is faster on mobile phones than laptops, but computers are essential for further use as communication or downloading forms, etcetera. The decision to include only TTSC students and all teachers was a good plan as the students of TTSC have compulsory curricular use of computers and administrative information access and understanding is gained by both the teachers and students. One student's comment, which was supported by other teachers and students, was "You trusted us with your two laptops and it was realized that there is nothing to be afraid of. If there is something wrong you could fix it and later even others could fix the same kind of problem". Evidently, the issues of trust and fear were reflected by this comment. It was also identified (see Table 3) that the reward and punishment strategy increased student participation, particularly the female students' participation increased dramatically. In terms of learning the skills, the students of class 12 reported that the interest and skills grow over time and it would have been better if the contest was experienced from class nine. An overall criticism of the students was that merely one hour of training for the contest does not give sufficient skills and the institution does not have convenient access to practice computer and Internet skills.

Table 3. TTSC Students' Enrolment for the 'Internet Master' Contest

Class	M	F	Total Strength	M	F	Total Participated
Nine (4 trades)	20	27	47	10	11	21
Computer	8	11	19	8	11	19
Poultry	5	4	9	0	0	0
Dress Making	0	12	12	0	0	0
Electrical	7	0	7	2	0	2
Ten (4 trades)	25	22	47	17	10	27
Computer	6	9	15	6	9	15
Poultry	9	0	9	5	0	5
Dress Making	0	13	13	0	1	1
Electrical	10	0	10	6	0	6
Eleven (2 tr.)	23	16	39	16	10	26
Accounting	13	10	23	9	4	13
Computer	10	6	16	7	6	13
Twelve (2 tr.)	25	12	37	19	10	29
Accounting	16	4	20	11	2	13
Computer	9	8	17	8	8	16
Grand Total	93	77	170	62	41	103

4.1.4. *Internet Master Contest 2012: R&P-5*

This was the last activity as part of my research project and facilitation. After the contest some participants, the organizing team of teachers and students, and other teachers and staff pointed out the following in response to my question, "What next?". Much of the participation was contributed by the ICT committee, which was formed as part of the organizational process to operate strategic activities for the adoption of ICT. The principal is the chairperson and Mr. Salim is the convener. So, in the end they came to question, "What leaves with me?" These are funding, the role of an expert teacher/trainer, creating motivation through the school's management, inspiring teachers amid a high workload, and sharing the workload in the role of an organizer teacher. There are sufficient skilled students and teachers in the institution who will be able to organize subsequent contents if funding is available for organizing the event and the management gives sufficient motivation. However, it was also recognized that technical support from students like Pritom, Junaid, Sazzad, and Tanvir had been a pre-requisite to organizing the Mobile Master Contest. Furthermore, it was also discussed that if the mobiles of the contestants were relatively more high-end, then it would have been possible to hold the contest very easily. In the relatively near future, when the community members have

better phones, it would be more convenient to organize the Mobile Master Contest than the Internet Master Contest and there will be more Internet practice. While the above-discussed barriers are associated with the *access* barriers of Internet literacy, in the case of *understanding* the information on the Internet, the major barrier is the lack of English proficiency (see Figure 3).

As part of my personal inquiry about diffusion among family members, FGDs were conducted in each of the classes. The findings, in brief, were that less than 10% of the students of the institution faced the question “What did you learn?”. However, more than 90% of the families either asked, “Why are you late today?” or “Did you win anything in the contest?” or nothing was shared regarding the event. The reasons are related to lack of formal education of the family members or other factors in the family or social practice. Only the winners of these contests got motivation from the family members and among the majority of those who could not win, some received criticism, some received motivation, and some did not hear anything in reply.

Based on the above discussions, I now point toward the *outcome* of the activity system of the extracurricular activities. It is warranted that the activity system of the extracurricular contest could provide a strategic approach for learning Internet literacy for both the organizers, contestants, and participants. However, one of the desires to diffuse Internet literacy among the alumnus and the family members of the teachers and the students could not bring much participation and was discontinued. The barriers that resist the *community* to sustainably adopt the extracurricular contests are associated with the learning environment. The lack of funding, lack of teachers, and high workload are also barriers to the adoption in the classroom activities (Khalid & Nyvang, 2013). However, as opposed to the ICT integration in curricular activities, these extracurricular contests did not present major resistances from individual teachers and created a relatively convenient atmosphere.

4.2. *Developing Questionnaires for Training and Contests on Internet Literacy*

Central to this section is the application of Bloom’s taxonomy as a tool to analyze the process of developing questionnaires for training and contests on Internet literacy. This research issue originated from the members of the organizing group and involves the analysis of three inquiries as follows.

First, the participants identified the needs and awareness in relation to Internet use. The contest trainees’ and facilitators’ analyses on these inquiries are summarized from the ethnographic notes of the FGDs, which were conducted as part of each training session of each of the contests. In addition, the final sets of questions of each of the four contests are also considered for verification. Table 4 summarizes the notes on the FGDs of the first Mobile Master Contest for the first inquiry. Some of these were expressed as needs and others were expressed as suggested questions for awareness creation.

Table 4. Training Participants' Needs and Awareness Questions in Relation to Internet Use

Specific description	Type of common Internet use (Johnson, 2007)
Using email, Facebook, and messengers for communicating with relatives in the city and abroad	Communication
Searching information about the results of state tests, identifying addresses of websites and information on different universities and national organizations, searching and downloading forms from government and educational websites, reading newspapers, to know about the foreign countries and cities where the family members work or live, general knowledge questions	Information
Listening to music, online radio, watching videos, and playing games	Recreation
Launching browser, understanding the search function, understanding the structure of website addresses, considering browser features and selecting a browser, comparing search sites and deciding to select one, functionalities of Facebook	Technical
No suggestion: lack of online payment system and trust	Commercial

Second, which of these needs and awareness regarding the type of Internet use can be included in the training and the contest questions? The training and exercise session after the FGD involved evaluation of the questions for inclusion in the questionnaire. Each training group was typically from the same class or group. So, the questions that were posed by a class of students or a subject teacher of a particular class were categories for both the class and the teacher group. Thereby, a pool of questions was developed from the series of training sessions with groups of students and teachers. During the training sessions, the outcome of the first inquiry was used to practice each of the specific questions that were compiled, both in English and Bengali. During this test phase, a few practicalities were considered for deciding if a question/need or awareness suggestion was difficult to use as part of the contest. Practically, the central reasons that were noted regarding the contest experiences can be summarized as follows: the low Internet speed that caused delayed responses, the laptop browser responds much more slowly than the mobile browser, considering the time and complexity in answering a question only searching and browsing questions can be set and only for *information use* of the Internet, and other types of use require a much longer time and involve greater complexity. Therefore, eventually the pool of questions dealt only with *information use*, with a requirement to either *search* or *browse*, and a few questions were kept open for instant quizzes that do not involve Internet use. The idea of mixing instant quizzes and browser searches was taken from the I-Genious contest and because the student-organizers considered this as a way to encourage people to remember some important Internet-related information. Finally, using the pool of questions, the non-contestant organizers and I prepared the final set of questions for the contest. For instance, in the Mobile Master Contest 2011 most of the questions were as follows, capital and currency of a country, name popular search engine and social networking sites, website addresses of national education boards or board results, website addresses of polytechnics and universities that are suggested to students, and other general knowledge questions on curricular content and national games and sports. The questions that were asked for the

Internet Master Contests were different only for the final round and involved greater complexities. In detail, each of the finalists was given a laptop, modem, and four questions. Each of the questions involved searching, selecting, browsing, and finding information from a webpage. The participant who shows the fastest response for each of the answers at the same time by using different tabs of a browser is the winner. It was interesting that each of the finalists had sufficient skills and confidence to demonstrate that position as the best, which was determined by mere lottery of getting early responses through unreliable Internet connectivity.

The third inquiry is the researcher's inquiry based on Bloom's taxonomy. This analysis demonstrates and emphasizes that Internet literacy includes a range of cognitive skills, which can be designed within extracurricular activities. Departing from Johnson's tabulation on required cognitive skills for common Internet use (Johnson, 2007, pp. 436-437), I demonstrate and argue that from the action of viewing the question on the LCD display to reading and pointing to the answer on the mobile phone, there are multiple cognitive skills involved (see Table 5). Moreover, for different types of questions and for different skill levels of students, it was found to be different. Furthermore, there is another dimension of these skills, which were revealed as the winners of each of the sub-groups of the contests (i.e. nine or more contestants) were asked to share the core skills of success to their fellow contestants and the audience. It was explained that typing a search key does not have to be exactly the same as the words in the question. One of the examples was that for finding the website of the Bangladesh Technical Education Board, it is sufficient to type in "tech edu board bd". Similarly, for finding the duration of the Second World War, the search keyword can be "duration WW2". Promptly making such keywords involves the additional cognitive skill of synthesis even before typing the keyword. The mobile master stated, "I have gained experience of searching and I can immediately say what kind of short keyword should be used". Thus, it is evident that experience with searching and browsing took this expert to a higher level, specifically at the analysis level, from which it is easier to synthesize by predicting a more efficient keyword. Therefore, the use of cognitive skills can vary among individuals as one demonstrates a synthesis skill and another demonstrates a comprehension skill. Furthermore, the example of the mobile master substantiates that cognitive skills develop by practicing the actions involved in searching information on the Internet and the training session and subsequent practices can enable individuals to demonstrate higher order cognitive skills in relation to Internet literacy.

Table 5. *Required Cognitive Skills to Understand a Question and Search Information on the Internet*

Question	Cognitive Skill	Demonstration of Cognitive Skill/Action
What is the address of the website of Comilla University?	Comprehension	1. Identify the search keyword
	Knowledge	2. Launch browser
	Application	3. Write/type in search keyword
	Analysis	4. Examine/point out appropriate answer
	Comprehension	5. Read the answer

The above-mentioned inquiries are also associated with the *subject*, *object*, and *outcome* component of the activity system of the extracurricular activity (see Figure 1). The subject involves the contestants and trainers. The object is the motivation of the subject. The *outcome* questions are “What do they learn?” and “What is the desired outcome?”. The contestants learn Internet literacy and develop the cognitive skills in the process of demonstrating the skills. The organizers learn about the *community’s* needs and awareness. Furthermore, the contestants and organizers share the *objects* or motivations through engaging in this extracurricular activity and thereby forming a *community* of Internet literates. This further creates a learning environment beyond the training sessions. However, this paper does not substantiate this claim of community formation with a theoretical founding; rather it indicates that the community exists in the learning environment of the school.

5. Conclusion and Recommendations

This paper investigates how school-based extracurricular contests can address some of the barriers in relation to the diffusion of Internet literacy. Surely, in-school curricular activities must also be considered.

Based on an EAR methodology, this paper demonstrates the role of a change agent in field-based facilitation in solving and circumventing the barriers. Three broad issues are addressed.

First, in the process of circumventing the barriers of access and understanding in relation to Internet use for information search, this study identifies some root causes behind the probable decision to discontinue, despite in-situ facilitation by a change agent. The access barriers include funding, lack of expert teacher/trainer and technical support, motivation from the school’s management, and lack of teachers’ inspiration due to high workload. Central to the understanding barrier is the lack of English proficiency. Surely these barriers and strategies to overcome them are relevant not only to the extracurricular domain, but also to an in-school curricular domain. Nevertheless, the research reported here has been restricted to the extracurricular domain to investigate the potential contribution of extracurricular activities.

Second, the study demonstrates the application of activity theory and building on the denotations of the components of the activity system in designing extracurricular contests using mobile phones and laptops to diffuse Internet literacy. In addition, this study reaffirms the use of activity theory in solving barriers or tensions that arise when new thinking and doing are brought to a situated context. Particularly, activity theory is found to be a very convenient tool to understand and explain the barriers, the learning aspects, and the formation of community in relation to different types of stakeholders and their roles in the extracurricular activities.

Third, extracurricular contests can be designed to diffuse Internet literacy and the contestants’ actions involve a significant level of cognitive skills. These skills are developed through the actions required for answering each of the questions and the process of training and contesting. The processes of understanding a question in the

contest, performing the required activity on the Internet through a mobile or computer, and responding with the right answer involves each of the levels of cognitive skills in Bloom's taxonomy. More expert users demonstrate a higher level of cognitive skills in performing the same action. Participatory approaches enable contestant-oriented and needs/awareness based learning; this is similar to the problem-based learning approach.

This study identified some issues for further analysis. For instance, strategies to influence the affective domain of learning contributed in the transformation of attitudes of students, teachers, and student-participants' parents, who had negative attitudes toward Internet use. Furthermore, the planning involved a long-term strategic plan and a short-term action plan. For instance, the long-term strategic plan involved holding the event on a working day, allocating reward and punishment marks for attendance, and peer-group training. A short-term planning phase for the second Mobile Master Contest cancelled the long-term plan for holding the event, as it was identified that key resource persons (students) for technical support and training were unavailable, and organizing the event would take much longer.

To end, I have a recommendation that suggests a scale-up pilot research with more schools in one or a few administrative regions. It was my field-based change agent role that enabled me to identify the expert users of the Internet among the students and these voluntary experts contributed the most in training, technical support, and persuading people to participate. Rogers terms them as an *aide*,

a less than fully professional change agent who intensively contacts clients to influence their innovation-decisions.... the aides are socially closer to the lowest-status members of the user system that they serve. (1995, p. 351)

As a national strategy, the secondary educational institutions can be provided with nominal funding of about USD 200 for the cost of organizing the event for about 300 students. In addition, an educational technologist can be assigned to facilitate multiple schools within an area for identifying *aides* and facilitating institutionalizing the practice. However, expertise required for ICT adoption in relation to learning is different from a doctor or health worker, who are also viewed differently than teachers or trainers. Therefore, for ensuring in-situ facilitation, at least for the initial state, one educational technologist can be assigned for multiple educational institutions. I take this idea from the Danish facilitation strategy, which provides IT supervisors to 96% of Danish elementary schools (Danmarks Evalueringsinstitut, 2009).

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